

**THE GENUS BRIDELIA (EUPHORBIACEAE) IN MALESIA
AND INDOCHINA**
– A regional revision –

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SUMMARY

A taxonomic revision of *Bridelia* Willd. for Southeast Asia is presented together with comments on the characters used, the biogeography of the species involved and the phytographic history of the genus. Nineteen species are recognised for the region (one from New Guinea was recently described as new). A key and full descriptions are provided. Maps illustrate the distribution of 15 species. Several distributional patterns were found which mainly reflect ecological requirements. The currently accepted infrageneric delimitation (especially on the sectional level) as proposed by Jablonszky (1915) seems no longer to meet the demands of modern taxonomy and is used here only as a handy working tool, but no attempt is undertaken to propose a new one.

INTRODUCTION

In 1806, C.L. Willdenow published the generic name *Briedelia* to commemorate the bryologist S.E. Bridel (1761–1828). In 1818, K. Sprengel corrected Willdenow's spelling to *Bridelia* to match the name of the botanist honoured. This became common use in subsequent times and was accepted until several works (including some important reference works) recently adopted the original spelling again in application of Article 60.1 of the International Code of Botanical Nomenclature (Greuter et al., 1994). Therefore I have submitted a proposal to conserve Sprengel's generally used spelling in order to maintain nomenclatural stability (Dressler, 1996a).

The first important account of *Bridelia* was published by Müller Argoviensis (1866) in De Candolle's *Prodromus*. His species concept was rather wide, but he recognised many varieties in most of the species known to him. The following fundamental works have their origin in the 'Engler-school' in the beginning of this century: Gehrman (1908) published a precursor to a monograph of the genus in which he mainly focussed on African taxa, and Jablonszky (1915) fully revised the tribe Brideliaceae for Engler's *Pflanzenreich*. Jablonszky's work still contains the ultimate attempt of a complete generic treatment. More recent accounts on *Bridelia* appeared in several regional revisions or floras like Leandri (1958), Hutchinson & Dalziel (1958), Léonard (1955, 1962), Radcliffe-Smith (1987) for Africa and Airy Shaw for Asia (see below). Hooker f. (1887) provided the first major work on *Bridelia* in tropical Asia.

Before this revision started 18 species were recognised in the Malesian area (and another 11 species in Indochina) according to Airy Shaw's regional treatments (1972,

1975, 1980, 1981, 1982, 1983). In the course of this study, beside tracing several new synonyms, it became evident that the delimitation of certain Malesian taxa against those from the Southeast Asian mainland (Indochina) was unclear (e.g., *B. pubescens*, *B. griffithii*, *B. balansae*). Hence it was decided to include the Indochinese taxa as well and to cover the whole of Southeast Asia in this revision.

Concerning the infrafamiliar position of the genus there has never been confusion: the tribe Brideliaceae (consisting of *Bridelia* and *Cleistanthus* only) is well defined by its valvate aestivation and was always placed within the basal Phyllanthoideae due to its rather primitive flowers with a full perianth and bi-ovulate locules (Webster, 1994). Levin (1986b), however, concluded after a cladistic analysis that the relationships of Brideliaceae should be reassessed.

Both genera nearly share the same distributional range with *Cleistanthus* extending a bit further to the east reaching New Caledonia, and *Bridelia* a bit further to the north reaching the tropical part of the Himalayas and SW China.

Cleistanthus differs from *Bridelia* in the number of locules, 3 versus 2, the nature of the fruits, capsules versus (rarely dehiscent) drupes, and the type of venation: always brochidodromous secondary veins versus craspedodromous with a distinct fimbrial vein (brochidodromous in only one section: *Cleistanthoideae*).

With the reduction of the locule number in the ovary and the development of a fleshy drupaceous fruit *Bridelia* shows two advanced features compared to its closest relative *Cleistanthus*. Additionally, a camptodromous venation, as is the rule in *Cleistanthus*, is interpreted as primitive (Hickey & Wolfe, 1975). Hence it is likely that ancestral *Bridelia* is derived from *Cleistanthus* by the loss of one locule. The functional loss of an additional one in the ripe fruit led to the development of the taxa of *Bridelia* subg. *Gentilia*. This is, of course, only one of the possible evolutionary scenarios and purely intuitively derived.

SYSTEMATICS AND CHARACTERS

The last proposed infrageneric delimitation was made by Jablonszky (1915) who revised the tribe Brideliaceae for 'Das Pflanzenreich'. He accepted two subgenera: *Bridelia* and *Gentilia* (Beille) Jabl. The former is characterised by having bilocular fruits with plano-convex seeds, whereas the latter has unilocular fruits with one conspicuously sulcate seed. Both occur in the area studied: subg. *Bridelia* with both sections (*Stipulares* Gehrm.¹ and *Scleroneuræ* Gehrm.) recognised by Jablonszky and subg. *Gentilia* with only one section, *Cleistanthoideae* Gehrm.

Since *Bridelia triplocarya* with its usually trilocular fruits was described recently and since, e.g., *B. harmandii* and especially *B. macrocarpa* are intermediate between sections *Bridelia* and *Scleroneuræ* with regard to their flower size and stipule shape, certain gaps between Jablonszky's infrageneric taxa are filled. Therefore, I have adopted the system of Jablonszky only as a handy working hypothesis (and determination tool). I strongly advocate the elaboration of a critical delimitation based on a modern revision of the whole genus. Especially the grouping on sectional rank

1) According to the ICBN (Tokyo Code), the correct name is Section *Bridelia* as it includes the type species *B. scandens*.

requires a critical reassessment (see below). Levin (1986a) came to a similar conclusion after he had found species of the sections *Scleroneuræ* and *Micranthæ* belonging to different groups of venation types.

The most striking diagnostic characters among the taxa studied are, as mentioned, the number of locules in the fruits and hence the number and shape of the seeds per fruit. Usually, this can be judged already from the external morphology: unilocular fruits are circular in cross section, whereas bilocular fruits are often a bit compressed or show a bilobate apex. In Southeast Asia this separation matches with the venation pattern: section *Scleroneuræ* respectively *Bridelia* possess a distinct fimbrial vein with the secondary veins joining it (craspedodromous) whereas sect. *Cleistanthoidæ* lacks such a vein and the secondary veins arch inwards before they reach the margin and anastomose with upper next secondaries or branch in higher order loops (brochidodromous).

Other diagnostically important characters are discussed below:

Life form

The *Bridelia* species usually are (scrambling) shrubs or small to large timber trees. Only *B. whitmorei* seems to be unique in being a climber. *Bridelia harmandii* grows as a decumbent shrub and *B. parvifolia* as a dwarfy, sparingly branched shrub with a rather xeromorphic appearance.

Indumentum

Sometimes an indumentum is present on the branchlets, stipules, and young leaves, but only its presence on the lower surface of the leaves is of real diagnostic importance: certain species are entirely glabrous (*B. oligantha*, *B. ovata*, *B. parvifolia*, *B. adusta*, *B. balansæ*), while others have an indumentum which usually can vary from pilose or puberulous to tomentose. The variation is often rather great and reaches its peak in such widespread species as *B. glauca* or *B. tomentosa* where it ranges from glabrous to tomentose. This led to the separation of several varieties within these species. Two other species (*B. harmandii*, *B. stipularis*) are characterised by having strongly tomentose to velvety leaves (and often also such stipules, petioles and young branches).

Leaf size and shape

Usually, the foliage is rather variable, either in shape or in size. The species show elliptic to ovate or obovate leaves with an acute to obtuse apex and with an acuminate to blunt tip. But some species have such a distinctive shape that they are easily recognisable: *B. curtisii* has narrow-oblong leaves with both ends obtuse and conspicuously parallel side margins, and *B. oligantha* and *B. parvifolia* are characterised by their comparatively small, uniformly broadly elliptic to roundish leaves.

Venation

Beside the venation patterns mentioned above the following is of some diagnostic value: the number of secondary veins, their angle of divergence, and their branching towards the margin. The tertiary veins are either quite straightly percurrent and hence regularly scalariform or rather weakly irregularly percurrent with recurvatures to the midvein. The venation is normally rather prominent below in herbarium material.

Only *B. parvifolia* shows a faint prominence and *B. oligantha* has a smooth under-surface. (For a detailed description of venation features consult the taxonomic section and key!)

Inflorescence shape

Axillary glomerules of flowers are typical for *Bridelia*. They can either be situated on normally leaved branches (the majority of the species studied), along the smaller-leaved to leafless ends of string-like twigs (*B. stipularis*), or on special, (mostly) leafless terminal ends of twigs resembling a branched spike (*B. retusa*). Of further diagnostic importance is the number of flowers per glomerule: some species are recognisable by their few flowers (*B. balansae*, *B. oligantha*).

Flowers

There are fewer diagnostic differences to be found in the floral parts; the flowers are generally similar. Of some interest is the size of the expanded calyx (*B. insulana* with tiny flowers, *B. stipularis* with rather large flowers, Fig. 1a), the outer indumentum of the sepals (*B. harmandii* strongly woolly), the shape of the inner (tubular) pistillate disc (*B. pustulata* sometimes outside hairy, Fig. 5d; *B. stipularis* inside mostly with hairs, Fig. 1f, g), the exertion of the styles from the expanded flower, and the conspicuous pedicel which characterises *B. glauca* (Fig. 4). The petals are mostly tiny and very variable in shape within each species but not at all characteristic (Fig. 1c, d). The shape of the stamens and the ovary are not found to be of any diagnostic value. The lower part of the filaments is united to a staminal column (androphore) on the top of which the filaments expand star-like and a small pistillode is situated. The anthers are mostly dorsifixed and open longitudinally. The ovary is surrounded by a tubular inner disc which splits during fruit development into irregular disc scales (Fig. 1d–g).

Fruit

The fruit is a (mostly indehiscent) drupe with a persistent receptacle, perianth, and remnants of the two basally \pm united styles. Apart from the above mentioned sectional differences in fruit development (2 or 1 locule, shape) the size can be a tool for determination: *B. macrocarpa* is easily recognised by its for the genus huge, plum-shaped fruits (1.5–3 cm diam.) and *B. stipularis* has (according to its flower size) considerably big fruits (7–12 by 6–11 mm) with a typical shape (ellipsoid to subglobose, often barrel-shaped and dehiscent from apex, finally leaving receptacle, perianth and columella-like structure, Fig. 1g–i).

Relations among the taxa studied

For a summary of the characters and distributions of the species involved see Table 1.

Judging from the species studied I consider the separation between the subgenera reflecting natural groups as already indicated above. The distinction of two sections within subg. *Bridelia*, however, seems worth reconsideration since several species are intermediate between both taxa.

Bridelia stipularis, according to current taxonomic opinion the only species of sect. *Bridelia*, does not reach New Guinea but is replaced there by three closely re-

Table 1. Comparison of characters and distributions of Southeast Asian *Bridelia* species.

	6: Leaf width (mm)	11: Venation prominence	16: Flowers	21: Locules per fruit
1: Habit	7: Leaf index	12: Stipule shape	17: Pedicel length (mm)	22: No. fruits per glomerule
2: Leaf texture	8: Indumentum beneath	13: Stipule length (mm)	18: Calyx diam. (mm) staminate;	23: Fruit length (mm)
3: Leaf apex	9: Fimbrial vein	14: Inflorescence shape	19: Indumentum sepals [pistillate	24: Fruit diameter (mm)
4: Leaf base	10: No. secondary vein pairs	15: No. flowers per glomerule	20: Disc diam. (mm)	25: Distribution
5: Leaf length (mm)				
	2. <i>B. curtisii</i>	3. <i>B. erapensis</i>	4. <i>B. harmandii</i>	5. <i>B. macrocarpa</i>
	1: shrub to small tree	tree	decumbent shrub	tree
2: chartaceous	scrambling shrub to small tree	subcoriaceous	stiffly coriaceous	chartaceous
3: acute-obtuse	stiffly (sub)coriaceous	acute-obtuse	obtuse (bluntly acute)	acute-obtuse (emarginate)
4: obtuse-acute	obtuse-round	cordate-obtuse	round (cordate)	obtuse-round (acute)
5: 44-220	30-80	30-100	(22) 30-80	20-60
6: 26-87	10-36	20-60	13-56	13-43
7: 1.4-3.3	1.5-2.8	1.5-1.97	1.3-2.1	1.1-2 (2.15)
8: puberulous-pubescent	glabrous (puberulous)	puberulous	tomentose-velvety	glabrous
9: +	+	+	+	+
10: (9) 11-15	5-10 (12)	14-18	7-10 (12)	8-11
11: prominent	prominent	prominent	prominent	not prominent
12: subulate	narrow triangular	?	subulate	narrow triangular-linear
13: 4-5	< 4	?	< 6	1-2
14: axils normal leaves	axils normal leaves	axils normal leaves	axils normal leaves	axils normal leaves
15: < 11	< 13	2-5	3-6	1-6 (8)
16: sessile	sessile	sessile	(8) 9-16	sessile
17: < 0.5	< 0.5 (1)	< 0.5	< 1	< 0.5
18: 4-6	3-5	3.5-5	(3) 4-5; 5-6	3-4
19: glabrous	glabrous	glabrous	tomentose (pubescent)	glabrous
20: 2.5-3	< 2.5	< 2	1.4-2	1.8-2
21: 2	2	2	2	2
22: 1-2	2-3 (6)	< 4	< 3 (4)	1(-3)
23: 5-7	4.5-6.5	5-6	5-7	4.5-5
24: 5-8	4.5-6.5	5-6	4-6	3.5-4
25: China, Thailand	Indochina, Thailand, Malay Peninsula, N Sumatra	New Guinea	Thailand, Indochina	New Guinea

(Table 1 continued)

	6: Leaf width (mm)	11: Venation prominence	16: Flowers	21: Locules per fruit
	7: Leaf index	12: Stipule shape	17: Pedicel length (mm)	22: No. fruits per glomerule
	8: Indumentum beneath	13: Stipule length (mm)	18: Calyx diam. (mm) staminate;	23: Fruit length (mm)
	9: Fimbrial vein	14: Inflorescence shape	19: Indumentum sepals [pistillate	24: Fruit diameter (mm)
	10: No. secondary vein pairs	15: No. flowers per glomerule	20: Disc diam. (mm)	25: Distribution
7. <i>B. ovata</i>				
8. <i>B. parvifolia</i>				
1: scrambling shrub to small tree	small shrub	tree	scrambling shrub to small tree	tree
2: chartaceous	stiffly chartaceous	stiffly (sub)chartaceous	thinly chartaceous	coriaceous
3: obtuse-round (bluntly acute)	obtuse-round	acute-obtuse (emarginate)	acute-bluntly acuminate	acute (obtuse)
4: leaf (cordate)	acute-round	round-obtuse (acute)	obtuse (acute)	acute-obtuse
5: 50-180	16-64	63-253	25-140	40-110
6: 20-80 (100)	13-43	30-115	10-60	15-45
7: 1.4-2.2	1-1.9	1.4-2.7	>2 (1.7-3.7)	1.9-3
8: glabrous	glabrous	pubescent-tomentose (glabrous)	glabrous-tomentose	puberulous-pubescent
9: +	+	+	+	+
10: 12-20	(5) 7-8 (9)	(16) 19-23 (27)	(5) 7-11 (13)	10-14
11: prominent	faintly prominent	prominent	weakly prominent	prominent
12: narrow triangular	ovate-triangular	ovate-triangular	ovate-triangular	narrow triangular
13: <7 (10)	2-4	<2	2-4 (5)	<3
14: axils normal leaves	axils normal leaves	spike-like	axils normal leaves	axils normal leaves
15: 1-20	3-7 (9)	(3) 8-15	>6	2-5
16: subsessile-shortly stalked	sessile	(sub)sessile	sessile	sessile
17: <2 (2.5)	<0.5	<2	<1	<0.5
18: 3-5; 4-6	4-5; 5-7	4-5.5	2-3; 3-4	4-5
19: glabrous	glabrous	glabrous-basally pilose	glabrous	glabrous
20: 2-2.5	1.6-2.5	1.2-2.5	1-2.5	?
21: 2 (3)	2	2	2 (3)	(2) 3
22: <10	1-2	1-3	<8	1-2
23: 5-7	6-7	5-8	4.5-6.5	8-9
24: 6-8	4.5-6.5	6-11	4.5-6.5	6-8
25: SE Asia mainland, E Java, Lesser Sunda Islands	China, Indochina	India-Sumatra	India-Australia	New Guinea

(Table 1 continued)

	13. <i>B. adusta</i>	14. <i>B. balansae</i>	15. <i>B. cinnamomea</i>	16. <i>B. glauca</i>	17. <i>B. insulana</i>	18. <i>B. pustulata</i>	19. <i>B. whimorei</i>
1: tree	shrub to small tree	scrambling shrub to small tree	tree	tree	tree	climber	
2: stiffly coriaceous	stiffly chartaceous-subcoriaceous	chartaceous	chartaceous (subcoriaceous)	chartaceous (subcoriaceous)	subcoriaceous-chartaceous	(sub)coriaceous	
3: acuminate	acute-acuminate	acute-round, acuminate	acute-acuminate	obtuse-acute, acuminate	obtuse-acute, acuminate	obtuse (acute, acuminate)	
4: cuneate-round	acute (obtus)	acute (round)	acute, obtuse, truncate	obtuse, round, acute	obtuse, round, acute	round (acute, obtuse, cordate)	
5: 40-100	50-150	40-120	40-280	45-210	90-230	65-140	
6: 15-35	18-65	18-65	20-120	25-88	30-115	30-65	
7: 2.4-3.2	2-3.4 (3.7)	1.5-2.4	1.9-3.1	1.5-2.7	1.6-3	1.7-2.4	
8: glabrous	glabrous	puberulous-pubescent	pubescent-tomentose (glabrous)	glabrous (puberulous)	puberulous	glabrous	
9: -	-	-	-	-	-	-	
10: 7-9 (11)	8-12 (13)	(5) 6-9 (10)	(7) 11-18 (20)	9-13 (14)	11-12	9-12	
11: not prominent	prominent	prominent	prominent	prominent	prominent	prominent	
12: narrow triangular-subulate	ovate-triangular	ovate	ovate-triangular	narrow triangular	linear-narrow triangular	?	
13: 5-8	< 1.8	1.5-2	8-12	< 5	< 8	?	
14: axils normal leaves	axils normal leaves	axils normal leaves	axils normal leaves	axils normal leaves	axils normal leaves	axils normal leaves	
15: < 11	< 10 (12)	10-20	< 50	15-30	> 20	< 9	
16: sessile	sessile	sessile-shortly stalked	stalked	sessile	sessile	sessile	
17: < 1	1.5-2	< 3	(1) 2-6	< 1.5	< 0.3	< 0.3	
18: 2.5-4	(3.5) 4-5	4-5	3-5	2-2.5; 2-3 (3.5)	3-4	?; 5-7	
19: puberulous	puberulous	puberulous	pubescent-puberulous	puberulous	puberulous	puberulous	
20: 1.5-2	2-3	< 1.8	1.2-2	1-1.2	1.2-1.7	?	
21: 1	1	1	1	1	1	1	
22: ?	< 6	3-4	< 9	< 11	< 11	< 6	
23: 7-8	8-11 (14)	6-7	5.5-10 (12)	6-11	7-8	< 12	
24: 5-8	5-7	5-5.5	4.5-7.5 (9)	4-6	5-7	< 8	
25: N Borneo	S China, Ryukyus, Taiwan, Laos, Vietnam	Thailand, Malay Peninsula, Sumatra, Borneo	Indo-Malesia	SE Asia mainland, Malesia, Australia	Malay Peninsula, Sumatra, Borneo, Philippines	Malay Peninsula	

lated species which are all, more or less, intermediate between both sections, e. g. in flower size, stipule shape. Their ancestor(s), possibly closely related to *B. stipularis*, could have reached New Guinea and speciated into different directions: *B. erapensis* is morphologically most similar to *B. stipularis*, whereas *B. macrocarpa* develops occasionally a single one, and *B. triplocarya* usually trilocular fruits. In Indochina *B. harmandii* is morphologically most similar to the widespread *B. stipularis* (few, rather big flowers, indumentum) and also resembles *B. tomentosa* var. *tomentosa* of sect. *Scleroneurae*.

The widespread (India to Australia) and hence rather diverse *B. tomentosa* is morphologically connected with *B. ovata* (Indochina to Peninsular Malaysia, Java, Lesser Sunda Islands) via *B. curtisii* (Indochina to Sumatra) by leaf and stipule shape, indumentum, fruit size, and via *B. oligantha*, a locally endemic species from New Guinea, by leaf shape, number of secondary veins, and leaf colour in its dry state.

Bridelia affinis seems closely related to *B. tomentosa* as well (leaf shape, habit, indumentum), whereas *B. parvifolia* is rather allied with *B. ovata* in some features (leaf shape, lack of indumentum, flower number and size, leaf colour after drying). The lower number of the secondary veins in *B. parvifolia* seems to be consistent with the smaller leaf size.

Concerning sect. *Cleistanthoideae* my ideas are more vague. Besides this section, subg. *Gentilia* comprises three other sections, *Micranthae*, *Neogoetzea*, *Dubiae*. Both *Micranthae* and *Neogoetzea* accommodate species of a strictly African distribution. But judging from the literature, the distinction between the brochidodromous and craspedodromous venation pattern (sect. *Cleistanthoideae* versus the other three) seems to justify taxonomic ranking. A grouping based on the stipule shape, however, (differentiating character among the other three sections) is not supportable according to my experience. The pattern of inflorescence glomerules situated in the axils of normally developed leaves (sect. *Micranthae*) or in the axils of smaller or even caducuous leaves, and hence spike-like appearance (sect. *Neogoetzea*), is comparable with the inflorescence structure of *B. stipularis* or *B. retusa*, where it was not used for sectional subdivision. In any case a new infrageneric classification is urgently needed.

The Southeast Asian species may be grouped as follows: the widespread Malesian *B. insulana* is geographically vicariant with the morphologically similar Indo-Chinese to South Chinese *B. balansae* from which it is mainly divergent by its larger number of smaller flowers and the weaker leaf texture. Both are closely related.

The widespread *B. glauca* is sympatric with both, and morphologically related likewise. Its variability led to the separation of several species (*B. acuminatissima*, *B. sosopodonica*, *B. pubescens*) of which the former two are recognised here but merely as varieties. The rather poorly known local endemic *B. adusta* resembles *B. glauca* in leaf shape and shares the perigynous flower. It is, however, distinct in other features such as leaf texture and secondary venation.

Two morphologically similar but ecologically separated sympatric species, *B. pustulata* and *B. cinnamomea*, are obviously closely related and show some parallels with *B. insulana* (e. g., leaf size, secondary venation, number of flowers).

The poorly known *B. whitmorei* seems to be rather isolated in its morphology among the species studied (e. g., climber, bullate intercostal areas, hairy ovary), so that its affinities remain unclear.

BIOGEOGRAPHY

Bridelia shares its distribution in the Old World tropics with *Cleistanthus* which exhibits some more plesiomorphic characters such as the trilocular ovary, the woody capsular fruit, and the camptodromous secondary venation. It is likely that ancestral taxa of *Bridelia* invaded the Malesian region from the Asian mainland and reached Australia. *Bridelia tomentosa* (subg. *Bridelia*) (Map 6) and *B. glauca* (subg. *Gentilia*) (Map 10) with their recent Indo-Australian distribution may be taken as a modern reflection of that. Hence, Van Steenis' (1979: 120) remark, "consisting of almost only (African-) Asian spp. and hardly Australian", on his pattern 4 (Indo-Australian widespread species absent from the Sunda Shelf) can also be illustrated with *Bridelia*. Towards the East the genus goes as far as the New Hebrides (*B. insulana*) (Map 11). The nature of the fruit (fleshy drupe) and its probable endozoochorous dispersal mechanism supports an island-hopping hypothesis too.

Section *Scleroneurae*, the main group of subg. *Bridelia*, is widespread throughout the whole distributional range of the genus (Africa and Asia) whereas sect. *Cleistanthoideae* of subg. *Gentilia* is known only from Asia with its main centre of diversity in the area studied. Together with the unilocular fruit which is considered to be an advanced feature, this fact leads to the assumption that the latter section is a rather young and modern group. It has colonised the Malay Archipelago furthest to the East and seems to be there still under speciation with its morphologically diverse *B. glauca* and *B. insulana*.

Within subg. *Bridelia* we find widespread elements (Indo-West Malesian *B. retusa*, Indo-Malesian *B. stipularis*, Indo-Australian *B. tomentosa*) (Maps 4, 5, 6), species with a more restricted distribution [Indochinese–West Malesian *B. curtisii* and *B. ovata* (Maps 1, 3), Indochinese *B. affinis*, *B. harmandii*], as well as obviously rare local endemics [New Guinean *B. triplocarya*, *B. macrocarpa*, *B. oligantha*, *B. erapensis* (Map 2); Indochinese *B. parvifolia*]. A noteworthy observation is that the widespread *B. stipularis* does not cross the Zollinger line eastwards, but is replaced in New Guinea by the morphologically related species *B. macrocarpa*, *B. erapensis*, and *B. triplocarya* (for their ecology see below).

As already stated sect. *Cleistanthoideae* of subg. *Gentilia* has its main centre of diversity in the area studied with only *B. moonii* occurring outside (in Sri Lanka). This section, too, contains widespread elements like the Malesian–Australian *B. insulana* (Map 11) and the even Indo-Australian *B. glauca* (Map 10). The nearly sympatric but ecologically vicariant (primary forests vs. peat swamps) species *B. pustulata* (Map 12) and *B. cinnamomea* (Map 9) show a West Malesian distribution. *Bridelia balansae* (Map 8) is confined to Indochina, S China and the Ryukyu Islands and practically replaces *B. insulana* towards the North. Finally, there are two West Malesian local endemics in this section: *B. whitmorei* and *B. adusta* (Map 7).

Comparing the distribution of the species studied with the occurrence of everwet rain forest or monsoon influenced vegetation (Van Steenis, 1979: fig. 4, 5) revealed striking patterns and provided some explanation for distributional anomalies. These patterns reflect, firstly, ecological requirements.

The *everwet rain-forest pattern* unites species bound to the everwet habitats occurring in Peninsular Malaysia, Sumatra, Borneo, the eastern Philippines, and most

of New Guinea. *Bridelia pustulata* and *B. cinnamomea* are confined to the rain-forest cores of the Sunda Shelf, while *B. insulana* and *B. glauca* are two widespread species with a preference for everwet rain forests, that also tolerate moderately dry habitats (E Java, Lesser Sunda Islands, Australia).

The *seasonal drought pattern* is shown by species adapted to weakly to moderately dry monsoon conditions. They are usually widespread on the Southeast Asian mainland, W Philippines, E Java, Lesser Sunda Islands, some places in S New Guinea and Australia as well as in dry pockets (e.g. rainshadows) in the everwet areas (Sunda Shelf, New Guinea). Examples of this pattern are *B. stipularis* which is clearly absent from large parts of the everwet Sunda Shelf (Sumatra, Borneo, E Philippines) but is abundant on Java, the Lesser Sunda Islands, and in Indochina, and *B. retusa* which has a preference for a pronounced dry season and thus is absent from the everwet Malay Peninsula and confined to some dry pockets in Sumatra. *Bridelia balansae* and *B. curtisii* may be mentioned here as well. This pattern is, however, best represented by *B. tomentosa*: its absence from everwet cores in Borneo, New Guinea, and Sumatra is striking and matches perfectly with the occurrence of everwet rain forest in these areas. This explains the very few collections from Borneo already mentioned by Airy Shaw (1975: 65) (see also the taxonomic section of this revision). These collections stem from a restricted part in SE Borneo also marked to be a dry pocket in Van Steenis (1979: 107, fig. 5).

The *disjunct seasonal drought pattern* is represented by *B. ovata* with its preference for a distinct to severe dry monsoon which causes a typical disjunction (Thailand and E Java, Lesser Sunda Islands) with an absence from the everwet corridor. Van Steenis (1979: 125) gives an enumeration of Indo-Malesian widespread species absent from the Sunda Shelf. *Bridelia ovata* as an Indochinese–West Malesian species may be added to this list.

The *patterns of local endemism* merely represent the habitat preferences of species with locally restricted distribution belonging to the first two main patterns mentioned above: *B. adusta* and *B. whitmorei* grow under wet conditions on the Sunda Shelf. The three New Guinean endemics *B. macrocarpa*, *B. oligantha* and *B. erapensis* are bound to drier places or areas. *Bridelia oligantha* is a local endemic in the dry area around Port Moresby and *B. erapensis* is known only from the dry Markham River Valley near Lae.

It is striking that most of the representatives of sect. *Cleistanthoideae* of subg. *Gentilia* are adapted to everwet conditions. In particular those species which are limited to these conditions are few in number. They have a more restricted distribution within Malesia than drought-indifferent or -preferring species which form the majority within the whole genus. Assuming that each species of *Bridelia* undergoes the same rate of dispersal and diffusion (cf. their probable endozoochorous dispersal mechanism), this phenomenon can be explained by the longer existence of large drought areas (savannah corridor) since the sea-level lowering in the Pleistocene Ice Age (Van Steenis, 1979: 108; Morley & Flenley, 1987: 52). After the end of the glacial period and the shrinking of the dry areas to the present pockets, the range of these rain-forest species could have extended out of their refugia into the everwet core (Morley & Flenley, 1987: fig. 5.5). An alternative hypothesis is that the species of sect. *Cleistanthoideae* originated more recently on the Sunda Shelf.

The disjunct seasonal drought pattern is generally shown by drought dependent species which had a wider distribution in the savannah corridor during glacial times (Morley & Flenley, 1987: fig. 5.5) but which were unable to bear the everwet climate during the interglacials and/or the extension of the everwet core vegetation after the glacial period.

TAXONOMIC SECTION

BRIDELIA

Bridelia ('*Briedelia*') Willd., Sp. Pl. 4 (1806) 978; corr. Spreng., Anleit. Kenntn. Gew. ed. 2, 2 (1818) 887; Müll. Arg. in DC., Prodr. 15, 2 (1866) 492; Hook. f., Fl. Brit. India 5 (1887) 267; Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 1; Jabl. in Engl., Pflanzenr. Heft 65 (1915) 54; Ridl., Fl. Malay Penins. 3 (1924) 183; Gage, J. Asiat. Soc. Bengal. 75 (1936) 484; Backer & Bakh. f., Fl. Java 1 (1964) 475; Airy Shaw, Kew Bull. 26 (1972) 227; Whitmore, Tree Fl. Malaya 2 (1973) 74; Airy Shaw, Kew Bull., Add. Ser. 4 (1975) 63; *ibid.* 8 (1980) 43; Kew Bull. 36 (1981) 272; *ibid.* 37 (1982) 10; Enum. Euphorb. Philipp. Isl. (1983) 11; S. Dressler, Taxon 45 (1996) 337, *nom. cons. prop.* — Type species: *Bridelia scandens* (Roxb.) Willd. (lecto-type, designated by Webster, 1994: 39 and by Webster (?) in Greuter et al., 1993: 153).

Small trees to shrubs, sometimes scramblers, occasionally thorny from horizontal aerial roots or persisting twig bases, usually monoecious. *Bark* smooth or tearing off in scales or long stripes. *Indumentum* consisting of simple, appressed to patulous, short or longer hairs, at least on the young parts, in certain taxa lacking. *Branchlets* terete. *Leaves* petiolate, alternate, simple, smaller towards the twig tips. Stipules caducous. Petioles mostly thicker and darker than midvein. Blade symmetric, base obtuse to acute, apex obtuse, rounded, acute or acuminate, margin entire to slightly crenate. *Venation* pinnate, craspedodromous but secondaries terminating in a fimbrial vein (subg. *Bridelia*: sect. *Bridelia*, *Scleroneuræ* sensu Jabl., 1915) or brochidodromous (secondaries joined together in arches before the margin (subg. *Gentilia*: sect. *Cleistanthoideae*), secondary veins mostly uniformly, narrowly to moderately acutely angled, tertiary veins straight percurrent (scalariform) to weakly percurrent and re-curved towards midvein, areolation reticulate. *Inflorescences* scariously bracteate, axillary, glomerulate, sometimes spicate or terminal on leafless branchlets, dichlinous flowers in the same inflorescence with usually the central pistillate ones surrounded by staminate ones, dichogamous. *Flowers* usually small to minute, hypogynous, rarely perigynous, actinomorphic, whitish to greenish, sessile to shortly pedicelled, pedicel slightly elongating in fruit. *Sepals* 5, valvate, thick, fleshy, persistent in fruit. *Petals* 5, minute, alternate with sepals, very variable in shape, obovate or obcuneate, subentire to lobulate, thin. *Disc* plain, broadly pulvinate or saucer-shaped, lining the receptacle between the reproductive organs and the base of the perianth, fleshy, in pistillate flowers additional tubular inner disc present, conically truncate, membranaceous, enclosing the ovary and splitting into disc-scales adpressed to the outer portion of the disc during fruit development. *Stamens* 5, episepalous, filaments united below into a short central column, apically free, filiform and spreading, with pistillode terminating the column, anthers ovoid to ellipsoid, basifixed or dorsifixed, introrse, dithecal, tetrasporangiate, longitudinally dehiscent. *Ovary* 2- or 3-locular, locules each

with 2 ovules, anatropous, descending, epitropous, only 1 developing; in subg. *Gentilia* only one locule developing. *Styles* usually 2, free or united over a variable length, bifid above; stigmas terete to flat. *Fruit* a small drupe, ellipsoid to roundish, sometimes pointed or bilobate at apex, with fleshy mesocarp and hard endocarp which sometimes splits (e.g., *B. stipularis*, *B. ovata*), bilocular or 1-locular by abortion; if bilocular putamen subglobose with flat ventral and convex dorsal surface, if unilocular putamen ellipsoid. *Seeds* 1 (subg. *Gentilia*) or 2 (rarely 3) per fruit, ovoid and pointed or semiovoid with one flat, often sulcate side (if 2-seeded); testa smooth, glabrous, brownish. *Embryo* straight or slightly curved, cotyledons foliaceous, endosperm fleshy or membranaceous.

Distribution — About 50 species in the Old World tropics, distributed in Tropical Africa, Madagascar, Yemen and in Asia ranging from India and S China throughout Indochina, Malesia to N Australia and the Solomons and Vanuatu.

Habitat & Ecology — The species in Southeast Asia are usually part of the primary and secondary forest vegetation either as big trees or as smaller trees or shrubs in the understorey. Some species are scrambling and one is reported to be a climber. Some species seem to be restricted to a certain type of habitat, e.g., *B. cinnamomea* peat swamp forests, *B. parvifolia* sand dunes, *B. oligantha* dry savannahs.

The species occur from sea level up to 1800 m, but in sect. *Scleroneuræ* there are several species restricted to lower altitude.

Note — Closely related to *Cleistanthus*, with which it forms tribe Brideliaceae of subfam. Phyllanthoideae, but easily distinguishable by its drupaceous fruit and mostly 2-loculed ovary as well as by the often more chartaceous leaves with a different venation: *Cleistanthus* always has brochidodromous secondary veins whereas in *Bridelia* only sect. *Cleistanthoideae* of subg. *Gentilia* shows this feature. The greater part of the genus shows craspedodromous venation with secondary veins joining a fimbrial vein.

KEY TO THE SPECIES

- 1a. Leaves with a distinct fimbrial vein with secondary veins joining it (craspedodromous). Drupes bi- or trilocular. Seeds plano-convex (subg. *Bridelia*) . . . 2
- b. Leaves without a distinct fimbrial vein; secondary veins arching near the margin (brochidodromous). Drupes unilocular. Seeds ± ellipsoid with a deep longitudinal groove (subg. *Gentilia*) 14
- 2a. Ovary and drupes regularly trilocular. — Secondary veins (10–14 pairs) conspicuously steeply ascending. New Guinea **12. B. triplocarya**
- b. Ovary and drupes bilocular; rarely some trilocular may be present 3
- 3a. Flowers large, 6–12 mm diam. (calyx) 4
- b. Flowers small, up to 6 mm diam. (calyx) 5
- 4a. Secondary veins in 9–14 pairs. Leaves tomentose to velvety beneath. Fruits 6–11 mm diam., bilobate, often dehiscent at apex. Floral disc 4–6 mm diam. Sri Lanka to Lesser Sunda Islands **10. B. stipularis**
- b. Secondary veins in (12–)17–23 pairs. Leaves glabrous to pilose beneath. Fruits 17–30 mm diam., plum-like, rarely trilocular. Floral disc up to 3 mm diam. Halmahera, New Guinea **5. B. macrocarpa**

- 5a. Secondary veins usually in more than 12 pairs 6
 b. Secondary veins usually in less than 12 pairs 10
- 6a. Fruits very big, 1.5–3 cm diam., plum-like **5. *B. macrocarpa***
 b. Fruits smaller, up to 1.5 cm diam. 7
- 7a. Inflorescences terminal on mostly leafless twigs, spike-like. Secondary veins numerous (> 18 pairs). Leaves coriaceous **9. *B. retusa***
 b. Inflorescences in the axils of normal leaves. Secondary veins in less than 18 pairs. Leaves chartaceous to subcoriaceous 8
- 8a. Leaves glabrous beneath; drying to olive green to blackish **7. *B. ovata***
 b. Leaves puberulous to pubescent beneath 9
- 9a. Large tree. Leaves subcoriaceous, ovate. Secondary veins in 14–18 pairs. Calyx glabrous. New Guinea **3. *B. erapensis***
 b. Undershrub to small tree. Leaves chartaceous, elliptic. Secondary veins in 9–15 pairs. Calyx hairy at base, conspicuously red. Southeast Asia mainland
 **1. *B. affinis***
- 10a. Leaves thinly chartaceous, glaucous beneath. Apex (bluntly) acute to shortly acuminate. — Plant mostly rather delicate, twigs whip-like, slender
 **11. *B. tomentosa***
 b. Leaves stiffly chartaceous to coriaceous, lighter beneath. Apex obtuse to rounded. — Twigs more robust, often strongly branched 11
- 11a. Leaves tomentose to woolly beneath. Sepals pubescent to strongly tomentose outside **4. *B. harmandii***
 b. Leaves glabrous (*B. curtisii* rarely slightly puberulous). Sepals glabrous outside 12
- 12a. Leaves conspicuously narrow-oblong (leaf index > 2), stiffly (sub)coriaceous **2. *B. curtisii***
 b. Leaves broadly elliptic (leaf index 1–2), stiffly chartaceous 13
- 13a. Secondary veins in 6–8 pairs. Leaves blackish when dry. Flowers 4–7 mm in diam. Sparingly branched small shrub with short internodes, hence ‘spiny’ appearance. Indochina **8. *B. parvifolia***
 b. Secondary veins in 8–11 pairs. Leaves olive-green when dry. Flowers 3–4 mm in diam. Small tree to shrub. New Guinea **6. *B. oligantha***
- 14a. Big woody climber. Ovary hairy. Leaves drying greenish-brown, somewhat bul-
 late **19. *B. whitmorei***
 b. Bushes, scramblers or small trees. Ovary glabrous (tubular disc sometimes with hairs). Leaves ± plain 15
- 15a. Leaves puberulous to tomentose beneath 16
 b. Leaves glabrous beneath 19
- 16a. Inflorescence cushions strongly protruding, rather large (> 7 mm diam.). Plant nigrescently blackening when drying. Tertiary veins conspicuously ladder-like. Branchlets robust, rough, strongly pustulate-lenticellate. Pistillate tubular disc sometimes hairy outside **18. *B. pustulata***
 b. Inflorescence cushions smaller (< 7 mm diam.). Plant not nigrescent. Tertiary venation not conspicuously ladder-like. Branchlets less robust, neither rough nor pustulate. Pistillate tubular disc always glabrous outside 17

- 17a. Secondary veins in 6–9 pairs with a narrow acute angle of divergence ($< 45^\circ$). Leaf base mostly acute, apex very shortly acuminate (3–7 mm). Stipules very short (1.5–2 mm). Styles not exerted **15. *B. cinnamomea***
- b. Secondary veins in > 9 pairs with a moderately acute angle of divergence (usually $> 45^\circ$). Leaf base obtuse to truncate, rarely acute, apex longer acuminate. Stipules longer than 2 mm. Styles exerted 18
- 18a. Flowers conspicuously pedicelled (2–6 mm), 3–5 mm diam. Inflorescence cushions of rather ‘smooth’ appearance. Secondary veins in 11–18 pairs **16. *B. glauca***
- b. Flowers (sub)sessile, 2–3 mm diam. Inflorescence cushions of rather ‘rugged’ appearance. Secondary veins in 9–13 pairs . . . **17. *B. insulana* var. *subnuda***
- 19a. Inflorescence few-flowered (< 14). Leaves stiffly chartaceous to coriaceous, glossy above, margin revolute 20
- b. Inflorescence many-flowered (> 14). Leaves chartaceous, rarely subcoriaceous, usually dull above, margin not revolute 21
- 20a. Leaves lanceolate, mostly greenish brown when dry. Secondary veins in 8–12 pairs, mostly prominent beneath. Stipules up to 2 mm long . . **14. *B. balansae***
- b. Leaves elliptic, slightly ovate or obovate, conspicuously cinnamon-brownish when dry. Secondary veins in 7–9 pairs, not prominent beneath. Stipules 5–8 mm long **13. *B. adusta***
- 21a. Flowers conspicuously pedicelled (2–6 mm), 3–5 mm diam. Inflorescence cushions of rather ‘smooth’ appearance. Secondary veins in 11–18 pairs **16. *B. glauca* var. *acuminatissima***
- b. Flowers (sub)sessile, 2–3 mm diam. Inflorescence cushions of rather ‘rugged’ appearance. Secondary veins in 9–13 pairs **17. *B. insulana***

Subgenus *Bridelia*

Bridelia sect. *Eubridelia* Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 11, nom. inval. — *Bridelia* subg. *Eubridelia* (Gehrm.) Jabl. in Engl., Pflanzenz. Heft 65 (1915) 55, nom. inval.

1. *Bridelia affinis* Craib

Bridelia affinis Craib, Kew Bull. (1911) 456; Aberdeen Univ. Stud. No. 57 (1912) 182; Jabl. in Engl., Pflanzenz. Heft 65 (1915) 73; Airy Shaw, Kew Bull. 23 (1969) 65; Kew Bull. 26 (1972) 228. — Type: *Kerr 809* (K holo; BM, K iso), Thailand, Northern Region, Payap Circle, Chiangmai, Doi Sootep, 600 m, 16 Sept. 1909.

Bridelia henryana Jabl. in Engl., Pflanzenz. Heft 65 (1915) 62 (Airy Shaw, 1969, syn. nov.); Hand.-Mazz., Oest. Bot. Zeitschr. 80 (1931) 340; Anon., Fl. Hainanica 2 (1965) 143. — Type: *Henry 9666* [K lecto, here designated; E, K, PE (sec. P. T. Li, 1988), US (microfiche at K) iso], China, Yunnan, Mengtze, 1380–1410 m, c. 1897.

Bridelia colorata Airy Shaw, Kew Bull. 23 (1969) 66 (Airy Shaw, 1972, syn. nov.). — Type: *Winit 1487* (K holo; K iso), Thailand, Northern Region, Maharat Circle, Lampang, Me Saloi, 350 m, 28 Oct. 1925.

Bridelia tomentosa auct. non Blume: Gagnep. in Lecomte, Fl. Indo-Chine 5 (1926) 488; P. T. Li, Acta Phytotax. Sin. 26 (1988) 64.

Undershrub (1–3 m tall) or small tree (up to 6 m high). *Branches* slender, young puberulous and scattered lenticellate (elongate lenticels up to 1 mm diam.). *Stipules* conspicuously narrowly triangular, subulate, 4–5 mm long, at the base c. 1 mm wide, abaxially with a scattered pubescence, rather long persistent. *Leaves*: petiole terete, pubescent, 4–6(–7) mm long, 0.7–1.3(–1.5) mm diam.; lamina elliptic, often rather narrow, rarely slightly obovate, 44–220 by 26–87 mm, index 1.4–3.3, chartaceous, base obtuse to acute, apex acute to obtuse, margin entire to shallowly crenate where veins reach margin, rarely evenly crenulate. *Venation* prominent on both sides, stronger below, secondary veins in (9–)11–15 pairs, constantly arching towards and joining the marginal vein, tertiary veins often perpendicular to secondaries, but not very regular, scalariform. *Indumentum* whitish to light brownish, below puberulous to pubescent, above glabrous; leaves dark green above, pale light green or greyish beneath in natural state, sometimes glaucous in dry state. *Inflorescence*: glomerules with up to 10 (sub)sessile flowers, with pistillate flowers surrounded by staminate ones. *Bracts* triangular, c. 1.5 mm by 0.5 mm, scattered whitish hirsute. *Flowers* 4–6 mm diam., dark red, pedicel indistinct, up to 0.5 mm long. *Sepals* triangular, 1.5–3 by 1–1.5 mm, glabrous (only few hairs at base), conspicuously reddish (also when dry). *Petals* variable in shape, base spatulate, apex irregularly lobulate with gnawed margin, 1–1.2 by 1–1.3 mm, cream with darker midrib. *Disc* yellow, in staminate flowers c. 3 mm diam., outer one in pistillate flowers 2.5–3 mm diam., inner one 0.8–1 mm long when tubular, scales c. 1 mm long. *Anthers* ellipsoid, c. 0.6 by 0.3 mm, cream. Staminal column c. 1 mm long, 0.3 mm diam., pistillode cylindrical with blunt apex, c. 0.5 mm long, 0.2 mm diam. *Ovary* ovoid, apically tapering into 2 styles, c. 1 mm diam., c. 1.3 mm high, styles c. 3 mm long, about half of their length bifid, not exerted, stigma \pm lobed. *Infructescence*: 1 or 2 fruits, almost sessile on branchlets. *Fruit* depressed-globoid, 2-locular, bilobed, 5–7 mm high, 6–8 by 5–6 mm in diam., glossy green turning dark purplish black, remnants of styles, calyx greenish brown. *Putamen* semigloboid, 3.5 by 5 by 6 mm, light brown. *Seeds* not seen.

Distribution — China (Yunnan; Hainan sec. Fl. Hainanica, 1965), Thailand. The report for Indochina (Laos) by Airy Shaw (1972) relies on a misidentification of *Kerr 20845* (K).

Habitat — Found in undergrowth in deciduous or evergreen forests, also in disturbed places, 250–750 m altitude. Probably no preference to any soil type; reported from granite bedrocks, limestone mountains, and silica soils. Shade and humidity seemingly required, locally common.

Uses — Medicinal tree (Thailand, *Collins 1588*, K).

Notes — 1. *Bridelia affinis* (resp. *B. henryana*) has been synonymised with *B. tomentosa* by Gagnepain (1926) and Li (1988). Indeed there are some resemblances between both taxa, but nevertheless the former is easily distinguishable by its larger, shallowly crenate leaves and the larger flowers with conspicuous red calyx.

2. With the bilocular fruits and the perfectly developed fimbrial vein the present species clearly belongs to sect. *Scleroneuræ*. According to my opinion Airy Shaw (1969: 65) is wrong regarding his statements about the sectional identity of this species. A thorough look revealed that the fruits present on *Henry 9666A & B* are not unilocular at all.

3. There is a rather small-leaved montane form among the type material of *B. henryana* in Kew (*Henry 9666*, 4700 ft.) which is obviously a collection from a different site, but it represents *B. affinis* as well. Although I have to admit that the heterogeneous type material in Kew shows some features intermediate towards *B. tomentosa*, the large number of secondary veins (12–16 pairs) at the lectotype points towards *B. affinis*, as Airy Shaw (1969: 65) already stated.

2. *Bridelia curtisii* Hook. f.

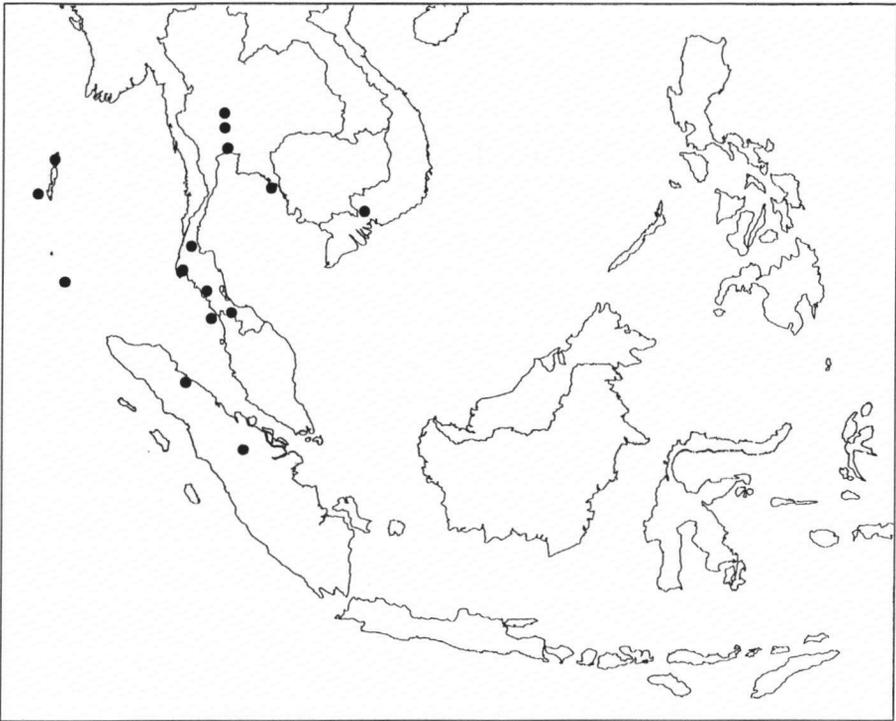
Bridelia curtisii Hook. f., Fl. Brit. India 5 (1887) 273; Boerl., Handl. Fl. Ned. Indië 3 (1900) 271; Ridl., J. Straits Branch Roy. Asiat. Soc. 59 (1911) 167; Fl. Malay Penins. 3 (1924) 184; Gage, J. Asiat. Soc. Bengal. 75 (1936) 488 (in obs.). — *Bridelia ovata* var. *curtisii* (Hook. f.) Airy Shaw, Kew Bull. 26 (1972) 229. — Type: *Curtis 97* (K holo; SING iso), Penang, at Tulloh Bahang, Nov. 1884.

Bridelia griffithii auct. non Hook. f.: Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 38.

Scrambling shrub to small tree, up to 7 m high. *Branches* spreading, glabrous to puberulous, with scattered lenticels. *Stipules* early caducous, narrow-triangular, glabrous, up to 4 mm long, 0.6–0.7 mm wide at base. *Leaves* characteristically shaped, petiole terete, glabrous, rarely puberulous, 3.5–6 mm long, 0.8–1.2 mm diam.; lamina conspicuously oblong with parallel or only slightly curved sides, rarely elliptic, exceptionally lanceolate, 30–80 by 10–36 mm, index mostly > 2 (1.5–2.8), stiffly coriaceous; base rounded or obtuse, rarely acute or slightly cordate; apex rounded, rarely bluntly acute; margin entire. *Venation* conspicuously prominent on both sides, secondary veins in 5–10(–12) pairs, arching and joining the marginal vein, tertiary veins irregularly percurrent, but mostly not scalariform, irregular reticulate areolation. *Indumentum* nearly glabrous to slightly puberulous, then also adaxially scattered hairs on the main nerves; leaves green above, greyish green beneath. *Inflorescence*: glomerules with up to 12 sessile, green flowers. *Bracts* many, broadly ovate-triangular, up to 1 by 0.8 mm, scattered puberulous and with ciliate margin. *Staminate flowers* 3–5 mm diam., pistillate flowers 4–5 mm diam., rarely with up to 1 mm long puberulous stalk. *Sepals* triangular-ovate, 1.5–2 by 1–1.5 mm, glabrous, greenish yellow. *Petals* very variable in shape, base cuneate to spatulate, apex roundish, notched or lobulate, up to 1 by 0.7 mm, whitish yellow. *Disc* glabrous, in staminate flowers 1.4–1.7 mm diam., outer one in pistillate flowers c. 2.5 mm diam., inner one tubular, up to 1 mm long, margin sometimes ciliate. Free part of *filaments* up to 0.7 mm long. *Anthers* shortly ellipsoid, 0.6–0.7 by 0.3–0.4 mm. *Staminal column* c. 1 mm long, up to 0.3 mm diam., pistillode conical-ovoid with 2-lobed top, up to 0.7 mm long, c. 0.2 mm diam. *Ovary* globoid, c. 1.5 mm diam., styles up to 1.2 mm long, basal half united, apically free, deeply bifid. *Infructescence* with up to 6 fruits, mostly 2 or 3. *Fruit* depressed-ovoid, apically emarginate, slightly bilobate, 4.5–6.5 mm diameter, i.v. fleshy, greenish purple, i.s. blackish. *Putamens* 2, with woody, brown, semigloboid, apically splitting endocarp, c. 4 by 5 by 2.5 mm, *Seeds* semigloboid to semi-tear-shaped, with lateral furrow, c. 3 by 4 by 2 mm, brown.

Field notes — Ripe berries eaten by *Myophoneus* (*van Balgooy 2379*, L).

Distribution — Indochina (Cambodia, Cochinchina), Thailand, Andaman & Nicobar Islands, Malay Peninsula, N Sumatra. — Map 1.



Map 1. Distribution of *Bridelia curtisii* Hook. f.

Habitat & Ecology — Reported from mangroves, tidal riversides, evergreen forests and open, disturbed areas (savannah); on low altitude (up to 25 m reported) often on limestone.

Uses — Fruits edible and medicinally used in Cambodia (*Martin 155, L*).

Notes — 1. The characteristics of this species are the typical oblong leaf mostly with both ends rounded, the stiffly coriaceous texture, and the prominent venation on both sides of the dry leaf. The plant is a scrambling shrub or small tree obviously confined to lower altitudes.

2. *Bridelia curtisii* is morphologically to be placed between *B. ovata* and *B. tomentosa*. Nevertheless it is clearly distinguished from both so that I consider it to be a distinct species in this closely related group. The main differences to *B. ovata* are the lower number of secondary veins and the stiffly coriaceous texture of the characteristically narrow-oblong leaves with both ends rounded (leaf index > 2). From *B. tomentosa* on the other hand it differs by having stiffer leaves, but also an often stronger growth habit with bigger leaves, flowers, and fruits. This species has an acute leaf apex and base.

3. Airy Shaw (1972a) mentioned *B. pedicellata* Ridl. as a synonym of *B. ovata* var. *curtisii*. Ridley himself (1924: 184) already synonymised this taxon with *B. ovata* but he did this with *B. curtisii* as well. Three of the four syntypes of *B. pedicellata* are housed in Kew and two of them have a leaf shape which superficially re-

sembles *B. curtisii*. To clarify this matter I lectotypify this species with *Ridley 8326* (K), a specimen which clearly represents *B. ovata*.

4. Strangely Gehrman (1908) placed *B. curtisii* among the synonyms of *B. griffithii* but said nothing about his reasons. Jablonszky (1915: 74) only cited Gehrman with the remark not to have seen the type. There is no justification for a conspecificity of these both species since they belong to the different subgenera.

5. Two collections from N Thailand (*Santisuk 1507* and *van Beusekom & Phengk-lai 2530*, both L) show a remarkable difference: their leaves are lanceolate with a distinctly acute apex. As there are no other macromorphological features which distinguish them from *B. curtisii*, to which they are most similar in leaf texture and venation, I did not venture to describe a new species although these collections seem clearly distinguished by their altitudinal occurrence too (1000–1400 m). Further material is needed to clear their taxonomic situation.

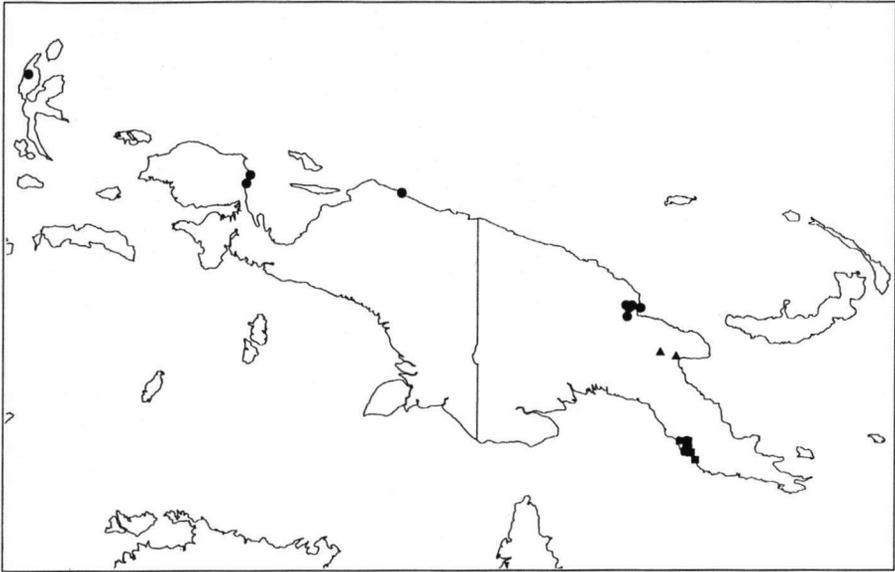
3. *Bridelia erapensis* S. Dressler

Bridelia erapensis S. Dressler, Kew Bull. 51 (3) (1996) 601, f. 1 (instructive fig.). — Type: *Hartley 12224* (L. holo; CANB n.v., K, LAE n.v. iso), Papua New Guinea, Morobe Prov., Markham River Valley at Erap, W of Lae along the Lae–Goroka road, 150 ft., 17 Sept. 1963.

Bridelia ovata auct. non Decne.: Hartley et al., Lloydia 36 (1973) 264.

Bridelia macrocarpa auct. non Airy Shaw: Airy Shaw, Kew Bull., Add. Ser. 8 (1980) 43, p. p.

Tree, up to 15 m high, stem 25 cm diam. Outer *bark* greyish brown, scaly and fissured, inner bark salmon or pink, blaze straw. Flowering *branches* slender, glabrous to pubescent, scattered lenticellate. *Stipules* not seen, early caducous. *Leaves*: petiole subterete, pilose to pubescent, 4–6 mm long, c. 1.2–2 mm diam.; lamina ovate, rarely elliptic, 3–10 by 2–6 cm, index 1.5–1.9, rigidly chartaceous to subcoriaceous, base obtuse, rounded to slightly cordate, apex obtuse to acute, margin entire to distantly shallowly crenate where veins reach the margin. *Venation* prominent on both sides, stronger below, secondary veins in 14–18 pairs, fairly straight, only slightly arching, but often forking before joining the fimbrial vein, secondaries often forming loops near the margin and tertiary veins joining the fimbrial vein, tertiary veins \pm patent to secondaries, percurrent, scalariform, reticulate areolation. *Indumentum* puberulous below, completely glabrous above; leaves i.v. dark green above, greyish green, often glaucous beneath. *Inflorescence*: paucibracteate glomerules of 2–5 sessile, greenish yellow flowers. *Bracts* (broadly) triangular, up to 1.3 by 1.2 mm, pilose to glabrous. Staminate *flowers* not seen, pistillate flowers 3.5–5 mm diam., up to 0.5 mm long stalked. *Sepals* triangular, 1.6–2.2 mm long, up to 1.7 mm wide at base, glabrous. *Petals* variable in shape, base spatulate to cuneate, apex triangular to lobulate with gnawed margin, 1–1.3 mm by 0.6–1 mm. Outer *disc* in pistillate flowers c. 2 mm diam., inner one up to 1.1 mm long, margin irregular erose to dentate. *Ovary* ellipsoid, conical at apex, 2-locular, c. 1.5 mm diam., c. 2 mm high, styles 0.8–1.3 mm long, deeply bifid, hence resembling 4 separate styles, stigmas lobate. *Infructescence* with up to 3 almost sessile fruits. *Fruit* globose, 5–6 mm long, 5–6 mm diam., smooth, green turning to purple when ripe. *Putamens* 2, semigloboid, with pointed base, c. 4.5 by 4.5 by 2.5–3 mm. *Seeds* semigloboid with shallow ventral furrow, c. 3 by 3.5 by 1.5 mm; testa reddish brown.



Map 2. Distribution of *Bridelia erapensis* S. Dressler (▲), *B. macrocarpa* Airy Shaw (●), and *B. oligantha* Airy Shaw (■).

Distribution — NE New Guinea. — Map 2.

Habitat & Ecology — Lowland monsoon or rain forests, reported from c. 45 m altitude.

Notes — 1. This new species was based on two collections from the Markham River Valley near Erap in the Morobe Province of New Guinea. The epithet refers to the locality, known to have a rather dry climate (Van Welzen, 1995, pers. comm.). A third collection (Clemens 10501, E) was later traced, also from the same area.

2. One of the specimens was mentioned by Airy Shaw (1980) under *B. macrocarpa* but with reference to its unusual cordate leaf base. As I found another vegetatively similar collection with much smaller bilocular fruits and as the combination of characters does not fit in any other species, the specimens have to be considered as an undescribed taxon. This species is characterised by ovate, basally obtuse to slightly cordate leaves of a (sub)coriaceous texture with a puberulous undersurface. Its venation pattern resembles more that of *B. triplocarya*. It has less secondary veins which often branch and curve before the margin, hence the secondaries form indistinct loops and join the fimbrial vein only sometimes. Tertiary veins arising from the branching of the secondaries join the fimbrial vein as well. It has only 2–5 flowers per glomerule and the fruits are bilocular and of only 5–6 mm diam. So it is clearly distinguished from *B. macrocarpa* and also from *B. triplocarya*.

4. *Bridelia harmandii* Gagnep.

Bridelia harmandii Gagnep., Bull. Soc. Bot. France 70 (1923) 433; in Lecomte, Fl. Indo-Chine 5 (1926) 491, f. 63.2–8; Airy Shaw, Kew Bull. 26 (1972) 228; Pham-hoang Ho, Cayco Vietnam 2 (1) (1992) 290. — Type: *Thorel 2172* (K lecto, here designated; P iso), Laos, Stung-streng, Bassac.

Small decumbent shrub (up to 60 cm high). *Branches* strongly pubescent to tomentose when young. *Stipules* very narrow-triangular, subulate, up to 6 mm long, < 1 mm wide at base, abaxially puberulous, rather long persistent. *Leaves*: petiole relatively short and stout, terete, densely tomentose, (2.5–)3–5 mm long, 1–2 mm diam.; lamina elliptic to broadly ovate, rarely slightly obovate, (22–)30–80 by 13–50(–56) mm, index 1.3–2.1 (1.72), stiffly coriaceous, base rounded, sometimes slightly cordate, apex obtuse, rarely bluntly acute, sometimes finely mucronate, margin entire to distantly faintly crenate where veins reach margin and i.s. slightly undulated. *Venation* prominent below, slightly so above, secondary veins in 7–10(–12) pairs, relatively straight, slightly curved before joining the fimbrial vein, sometimes branched, tertiary veins irregularly percurrent to reticulate, reticulate areolation. *Indumentum* puberulous to scabrous at veins above, later glabrous, densely pubescent to tomentose below; leaves i.v. green above, lighter, greyish green, sometimes glaucous below. *Inflorescence*: glomerules of 3–6(–10) subsessile whitish yellow flowers, each cluster with several tiny bracts. *Bracts* very variable in shape, (ovate-)triangular with concave sides, rarely with irregular apex, 1–2 mm by 0.9–1.5 mm, strongly pubescent to tomentose. *Staminate flowers* (3–)4–5 mm diam., often cup-shaped, not widely opened, *pistillate flowers* 5–6(–7 in fruit) mm diam. *Pedicel* short, up to 1 mm long, 0.1–0.2 mm diam., hairy. *Sepals* narrow ovate-triangular, 1.5–2 mm by c. 1 mm, abaxially (pubescent to) tomentose. *Petals* variable in shape, rotundate to elliptic, sometimes base cuneate to spatulate and apex slightly notched, 0.8–1.4 by 0.7–1.2 mm, rarely abaxially scattered hairs at midrib. *Disc* plain, in staminate flowers 1.4–2 mm diam., outer one in pistillate flowers c. 2 mm diam., inner one 0.6–0.7 mm long. Free part of *filaments* c. 0.5 mm long, 0.1 mm diam. *Anthers* shortly ellipsoid, 0.6–0.9 by 0.4–0.7 mm. *Staminal column* 0.8–1 mm long, *pistillode* stout, bluntly conical with bilobed top, 0.6–0.7 mm long, c. 0.3 mm diam. *Ovary* globoid, c. 1 mm diam., styles c. 1 mm long, deeply bifid, only very base united, shortly bilobed at apex. *Infructescence* with up to 3 (or 4) fruits. *Fruit* depressed- and compressed-globoid, bilobate, emarginate at apex, 5–7 by 3–5 by 4–6 mm, i.v. green, turning dull dark reddish to black. *Putamens* 2, semiglobose, woody, brown. *Seeds* semi-globoid with ventral furrow, 4 by 3.8 by 2.5 mm, shiny, roughish, blackish.

Distribution — Thailand, Indochina.

Habitat & Ecology — Deciduous forest, open dipterocarp forest from sea level up to 300 m altitude; reported from sandy soil.

Notes — 1. This species is characterised by its growth habit as a decumbent shrub, the densely pubescent to tomentose indumentum on young branches, and the abaxial side of stipules, leaves, and petals, the rather small elliptic leaves and by the subulate, relatively long persistent stipules. It has only few (mostly 3–6) flowers per inflorescence, which often do not open very wide. Superficially, it resembles a small-leaved *B. stipularis*, but the much smaller flowers, the fruit shape, and the lifeform distinguish both taxa well. It could also be confused with *B. tomentosa*, but it has stiffer coriaceous leaves, always a strong indumentum in many parts (also outside of the calyx), rather persistent subulate stipules, and less flowers per glomerule. *Bridelia harmandii* seems to be a rare endemic of continental Southeast Asia.

2. This species morphologically connects *B. stipularis* of sect. *Bridelia* with sect. *Scleroneuræ* within subg. *Eubridelia*.

5. *Bridelia macrocarpa* Airy Shaw

Bridelia macrocarpa Airy Shaw, Kew Bull. 25 (1971) 512; Kew Bull., Add. Ser. 8 (1980) 43, t. 1, f. 2. — Type: *Hoogland 4913* (K holo; CANB n.v., L, LAE n.v. iso), New Guinea, Madang Prov., near Mawan village, Gogol Valley, 200 m, 20 June 1955.

Bridelia beguinii Airy Shaw, Kew Bull. 37 (1982) 10; syn. nov. — Type: *Beguin 2039* (L holo; BO, L iso), Moluccas, Halmahera, Soa Tobaroe, 60 m, 22 June 1922.

Tall slender tree (up to 30 m high) with straight clear bole, thick buttresses (up to 1.5 m), and long forked crown. Outer *bark* dark greyish brown, flaking in square scales, with an acrid smell, underbark pale purple to red, inner bark pink or red, in papery layers, no exudation, sapwood white, cream or pinkish, heartwood brown, very hard. *Branches* slender, glabrous to scattered pilose, young glaucous. *Stipules* narrow-triangular, 5–7 mm long, 2.5–4 mm wide, whitish pubescent, early caducous. *Leaves*: petiole subterete, sparsely pilose, 7–13 mm long, c. 1–2.5 mm diam.; lamina broadly elliptic, sometimes obovate, 64–220 by 30–116 mm, index 1.3–2.6, chartaceous; base rounded to obtuse, rarely cordate; apex obtuse to acute, sometimes emarginate, margin entire to shallowly crenate where veins reach margin. *Venation* prominent on both sides, stronger below, secondary veins in (12–)17–23(–28) pairs, fairly straight, only slightly arching, but often forking before joining the marginal vein, tertiary veins \pm patent to secondaries, simple or rarely forked percurrent, scalariform. *Indumentum* whitish or brownish, below inconspicuously pilose to scabrate, above glabrous, only at veins pilose; leaves i.v. light to dark green above, greyish green, often glaucous beneath. *Inflorescence*: glomerules with (8–)9–16 sessile, yellowish green to creamy flowers, mostly not terminal and not at special leafless branches, with pistillate flowers surrounded by staminate ones. *Bracts* triangular to semi-ovate, up to 1.5 by 2 mm, whitish pilose. *Staminate flowers* 3.5–5 mm diam., pistillate flowers 6.5–10 mm diam. Pedicel indistinct, up to 0.5 mm long. *Sepals* triangular, 1.3–1.5 by c. 0.8 mm in staminate, 3–4 by 3–3.5 mm in pistillate flowers, glabrous. *Petals* variable in shape, base spatulate, apex roundish to lobulate with gnawed margin, (1–)1.5–2 by 1–1.5 mm. *Disc* in staminate flowers 1.8–2.5 mm diam., outer one in pistillate flowers 2.5–3 mm diameter, inner one 1–2 mm long when tubular, scales 1–1.3 mm long. Free part of *filaments* c. 0.8 mm long, 0.1 mm diam. *Anthers* ovoid, c. 0.5–0.8 by 0.3–0.4 mm. Staminal column 0.7–1.5 mm long, 0.2–0.5 mm diam., pistillode ovoid, bifid at apex, c. 0.5 mm long, 0.2 mm diam. *Ovary* globoid, conical at apex, pointed, 2-, rarely 3-locular, c. 2.5–3 mm diam., c. 2.5 mm high, styles 0.8–1 mm long, deeply bifid as to 4 separate styles. *Infructescence* with 1 almost sessile fruit. *Fruit* globose, 25 mm long, 17–30 mm in diam. (largest in the genus?), smooth, firm, succulent, red to purple in natural state; concerning the fruit in dried state cf. Airy Shaw (1971: protologue). Mature *putamens* and *endocarp* not seen, globular with 3 prominent vanes splitting along the vanes into 3 segments (sec. *Jackson 4567*), *seeds* suborbicular, narrowly concavo-convex, c. 1 cm diam.; testa reddish brown, cotyledons flat (sec. Airy Shaw).

Distribution — Moluccas (Halmahera), New Guinea. — Map 2.

Habitat & Ecology — Lowland rain forests, also tall secondary forest, from sea level up to 150 m altitude; on sandy or clayey soil, reported from flat, poorly drained or temporarily flooded terrain.

Uses — Reputation for durability of up to 10 years as posts, also used for carved bowls, lime sticks etc. (*Jackson 4567*, K, L).

Note — This species has some affinities with *B. stipularis* and *B. retusa*, both from S Asia and W Malesia, but nevertheless it is easily distinguishable by the large characteristic fruits which may have three seeds and by the lack of the special leafless branches which form the inflorescence. From *B. stipularis* it is easily distinguishable by having much more lateral veins and 8–16 flowers per glomerule. *Bridelia retusa* has similar but thicker and more coriaceous leaves.

6. *Bridelia oligantha* Airy Shaw

Bridelia oligantha Airy Shaw, Kew Bull. 32 (1978) 386; Kew Bull., Add. Ser. 8 (1980) 44; Kew Bull. 37 (1982) 11. — Type: *Pullen 6822* (K holo; A, BO, BRI n.v., CANB n.v., LAE n.v., US iso), Papua New Guinea, Central Prov., Port Moresby Subprov., Tavai Creek area, 72 km SE of Port Moresby, 45 m, 28 April 1967.

Shrub or small tree, to 8 m high, 10–20 cm diam. *Bark* grey, longitudinally grooved, wood cream. *Branches* slender, glabrous throughout, rarely pilose above inflorescence axils, scattered lenticellate. *Stipules* rather long persistent, narrow-triangular to linear, sometimes falcate, 1(–2) mm long, basally 0.5–0.7, medially c. 0.2 mm wide, margin ciliate. *Leaves* comparatively small, petiole terete, glabrous, 4–7 mm long, 0.8–1 mm diam.; lamina broadly elliptic, rarely slightly ovate, 2–6 by 1.3–4.3 cm, index 1.1–2(–2.1), stiffly chartaceous to subcoriaceous, base obtuse to rounded, rarely acute, apex obtuse to broadly rounded, rarely slightly emarginate, margin entire, rarely faintly crenate where veins reach margin. *Venation* faintly prominent to obscure on both sides, abaxially often rather inconspicuous, secondary veins in 8–11 pairs, rather irregular, straight to arching and joining the marginal vein, sometimes branched near margin, tertiary veins irregularly reticulate or rarely percurrent, not scalariform, reticulate areolation. *Indumentum* absent or exceptionally single hairs beneath; leaves i.v. olive green above, pale glaucous green beneath, i.s. greenish brown, sometimes glossy above, lighter beneath. *Inflorescence*: glomerules with 1–8 sessile greenish yellow flowers with several glabrous bracts. *Bracts* broadly triangular, 0.8–1.2 by c. 0.8 mm, with ciliate margin and thick, dark keel (midrib). *Flowers* 3–4 mm diam., staminate ones greenish cream. *Sepals* triangular, 1–1.5 mm long, 0.9–1.2 mm wide, glabrous. *Petals* very variable in shape, base cuneate, spatulate to nailed, apex roundish, rhomboidal or triangular, 0.6–1 mm by 0.4–1 mm, light with darker central part. *Disc* glabrous, in staminate flowers c. 1.8 mm diam., outer one in pistillate flowers c. 2 mm diam., inner one tubular with erose margin, up to 0.7 mm long. Free part of *filaments* very short, < 0.5 mm long. *Anthers* shortly ellipsoid, 0.4–0.6 by c. 0.3 mm. Staminal column c. 1 mm long, c. 0.3 mm diam., rather stout, pistillode shortly ovoid to bluntly conical, c. 0.5 mm long, c. 0.2 mm diam. *Ovary* globoid, c. 0.8 mm diam., styles 0.5–0.8 mm long, deeply bifid, only united at the base, apically bilobed, not exerted in flower. *Infructescence* with up to 3 fruits, mostly only 1. *Fruit* yellowish green i.v., slightly compressed globoid, sometimes subacute at base and apex, bilocular, 4.5–5 mm long, 3.5–4 mm diam., i.s. blackish. *Putamens* 2, endocarp brown, semigloboid, subacute at base and apex, apically often splitting, c. 3 by 4 by 2 mm. *Seeds* semigloboid, shallowly ventrally sulcate, c. 3 by 3 by 1.5 mm, brown, shining, embryo flat.

Field notes — One collector (*Pullen 6822*, type collection) noted that trees of this species in the area commonly have multiple trunks.

Distribution — New Guinea (Central Province: around Port Moresby). — Map 2.

Habitat & Ecology — Low monsoon thickets or forests, mixed savannah and grassland on very low altitudes, up to 50 m.

Notes — 1. Characteristic for *B. oligantha* are the rather small and broadly elliptic leaves with a smooth, perfectly glabrous undersurface as well as the few flowers per inflorescence only. The veins are normally not prominent. The very broadly round shape of the leaves and their thicker texture and smoother lower surface distinguish it from broad-leaved forms of *B. tomentosa* var. *glabrescens*. Without any doubt the latter species is very closely related to *B. oligantha*. Morphologically similar is *B. parvifolia* from Indochina, a rare small shrub from dune thickets. Here the internodes are often very short and the leaves are mostly conspicuously nigrescent as opposed to *B. oligantha* where they dry to a greenish brown colour.

2. I agree with Airy Shaw (1978) who stated that this species represents a distinct local endemic but I cannot confirm his reference to Timor (Airy Shaw, 1982: 11: *B. cf. oligantha*) which could possibly be based on a broad-leaved specimen of *B. tomentosa*. So far we know this species only from a restricted area near Port Moresby with a dry climate and savannah-like vegetation near the coast.

7. *Bridelia ovata* Decne.

Bridelia ovata Decne., *Nouv. Ann. Mus. Hist. Nat.* 3 (1834) 484; *Span., Linnaea* 15 (1841) 347; Baill., *Étude Euphorb.* (1858) 583; Miq., *Fl. Ned. Indië* 1, 2 (1859) 364; Müll. Arg. in DC., *Prodr.* 15, 2 (1866) 495; Kurz, *Prelim. Rep. For. Pegu, App. A: cix., App. B.* (1875) 78, in clavi; Kurz, *For. Fl. Burma* 2 (1877) 368; Fern.-Vill. in Blanco, *Fl. Philipp.*, ed. 3, Nov. App. 4 (1880) 186 (mentioned for Philippines?, see below); Hook. f., *Fl. Brit. India* 5 (1887) 274; Boerl., *Handl. Fl. Ned. Indië* 3 (1900) 271; Gehrm., *Bot. Jahrb. Syst.* 41, *Beibl.* 95 (1908) 33; J.J. Sm. in Koord. & Valetton, *Bijdr. Boomsoort. Java* 12 (1910) 324; Koord., *Exkurs.-Fl. Java* 2 (1912) 485, in clavi; Jabl. in Engl., *Pflanzenr. Heft* 65 (1915) 61, 63; Ridl., *Fl. Malay Penins.* 3 (1924) 184; Gagnep. in Lecomte, *Fl. Indo-Chine* 5 (1926) 489; Gage, *J. Asiat. Soc. Bengal.* 75 (1936) 488; Henderson, *J. Malayan Branch Roy. Asiat. Soc.* 17 (1939) 69; Corner, *Wayside Trees Malaya*, ed. 2, 1 (1951) 243, ed. 3, 1 (1988) 279; Backer & Bakh. f., *Fl. Java* 1 (1964) 475, in clavi; Airy Shaw, *Kew Bull.* 26 (1972) 229; Whitmore, *Tree Fl. Malaya* 2 (1973) 74, in clavi; Airy Shaw, *Kew Bull.* 37 (1982) 11; Pham-hoang Ho, *Cayco Vietnam* 2 (1992) 291. — *Amanoa ovata* (Decne.) Baill., *Adansonia* 6 (1866) 336, p.p. — *Bridelia ovata* var. *genuina* Müll. Arg. in DC., *Prodr.* 15, 2 (1866) 495, nom. inval. — Type: *Riedlé s.n.* [P holo; A, B (sec. Müll. Arg., 1866; destr.), E, K, L, NY iso], Timor.

Bridelia lanceolata Kurz ex Teijsm. & Binn., *Natuurk. Tijdschr. Ned.-Indië* 27 (1864) 45 (Gagnep., 1926: 489, syn. nov.). — *Cleistanthus lanceolatus* (Kurz ex Teijsm. & Binn.) Müll. Arg. in DC., *Prodr.* 15, 2 (1866) 507; Boerl., *Handl. Fl. Ned. Indië* 3 (1900) 271; Hallier f., *Meded. Rijks-Herb.* 1 (1910) 6. — Type: *Teijsmann s.n.* [BO; probable isotype: G-DC (n.v., IDC microfiche in L), K], Java, prope Japara.

Bridelia glauca auct. non Blume: Koord. in Junghuhn-Gedenkboek (1910) 173 (sec. Hallier f., 1910). *Bridelia ovata* var. *acutifolia* Müll. Arg. in DC., *Prodr.* 15, 2 (1866) 495, syn. nov. — Type: *Helper 4884* (G-DC, n.v., IDC microfiche in L), in Tenasserim and Andamans.

Bridelia burmanica Hook. f., *Fl. Brit. India* 5 (1887) 269, syn. nov.; Gehrm., *Bot. Jahrb. Syst.* 41, *Beibl.* 95 (1908) 28; Jabl. in Engl., *Pflanzenr. Heft* 65 (1915) 69; Gagnep. in Lecomte, *Fl. Indo-Chine* 5 (1926) 489. — Syntypes: *Wallich 7888* (BM, K, K-Wall.), Burma (Hort. Bot. Calc.); *Kurz s.n.* (BO), Burma, Ava.

Bridelia amoena auct. non Wall. ex Baill.: Kurz, For. Fl. Burma 2 (1877) 368.

Bridelia kurzii Hook. f., Fl. Brit. India 5 (1887) 272 (Gage, 1936: 489, syn. nov.); Williams, Bull. Herb. Boissier, sér. 2, 5 (1904) 31; Brandis, Indian Trees (1906) 560; Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 32; Jabl. in Engl., Pflanzenr. Heft 65 (1915) 65. — Type: *Kurz s.n.* (K holo), Nicobar Islands, Kamorta, Febr. 1875.

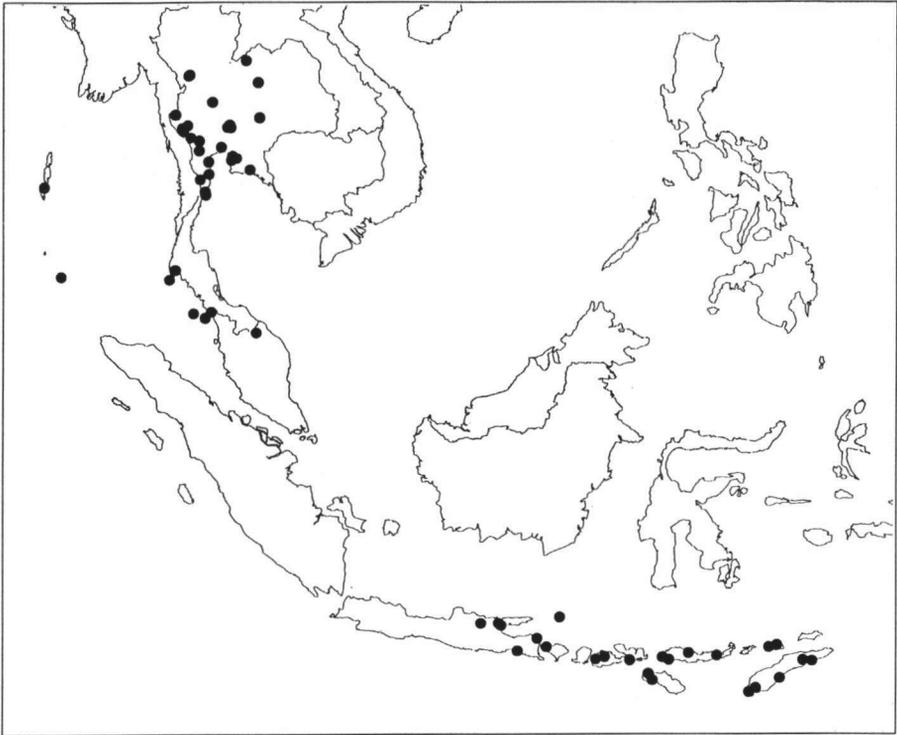
Bridelia pedicellata Ridl., J. Straits Branch Roy. Asiat. Soc. 59 (1911) 167 (Ridley, 1923: 184, syn. nov.); Jabl. in Engl., Pflanzenr. Heft 65 (1915) 63; Gagnep. in Lecomte, Fl. Indo-Chine 5 (1926) 490; Pham-hoang Ho, Cayco Vietnam 2 (1992) 291. — Type: *Ridley 8326* (K lecto, here designated; SING iso), Malaya, Kedah, Langkawi, Jan. 1897.

Bridelia kurzii auct. non Hook. f.: Williams, Bull. Herb. Boissier, sér. 2, 5 (1905) 31.

Scrambling shrub or small tree, up to 8 m high, 10 cm diam., with flattened crown and fissured, dark greyish brown *bark*. *Branches* glabrous, with scattered lenticels. *Stipules* early caducous, narrow-triangular, subulate, glabrous, up to 7(–10) mm long, up to 1.2 mm wide at base. *Leaves*: petiole terete, glabrous, (3–)4–6 mm long, 0.8–1.5 mm diam.; lamina elliptic, sometimes slightly obovate, 5–18 by 2–8(–10) cm, index mostly < 2, (1.4–2.2), chartaceous, base obtuse, rarely slightly cordate, apex obtuse to rounded, rarely bluntly acute, margin entire. *Venation* prominent on both sides, secondary veins in 13–17 pairs, arching and joining the marginal vein, sometimes branching, tertiary veins irregularly percurrent, sometimes scalariform, well-developed reticulate areolation. *Indumentum*: glabrous; leaves light green above, greyish green, and glaucous beneath; often conspicuously blackish olive when dry. *Inflorescence*: multibracteate glomerules of 1–20 (or more) subsessile to shortly pedicelled yellowish green flowers. *Bracts* ovate-triangular, up to 2 by 1–1.5 mm, with scattered hairs and membranaceous margin. Staminate *flowers* 3–5 mm diam., pistillate flowers 4–6 mm diam., subsessile to shortly stalked (the staminate flowers mostly), pedicel up to 2(–2.5) mm long, glabrous, pistillate flower base or pedicel often shorter and stouter, up to 1.5 mm diam. *Sepals* triangular, up to 2 mm long and 1.5 mm wide, glabrous, greenish cream tinged with red. *Petals* elliptic, apex roundish or notched, 0.5–1.2 by 0.7–1 mm, whitish yellow. *Disc* glabrous, in staminate flowers c. 2 mm diam., outer one in pistillate flowers c. 2.5 mm diam., inner one tubular, up to 1 mm long, fully covering the ovary. Free part of the *filaments* up to 0.8 mm long. *Anthers* shortly ellipsoid, c. 0.5 by 0.3–0.4 mm. Staminal column c. 1 mm long, up to 0.3 mm diameter, pistillode conical-ovoid with 2-lobed top, up to 0.7 mm long, c. 0.4 mm diam. *Ovary* globoid, c. 0.6–0.7(–1) mm diameter, styles up to 1.2 mm long, only the very base united, apically deeply bifid. *Infructescence* with up to 9 fruits. *Fruit* depressed-ellipsoid, emarginate at apex, bilobate, sometimes obconical at base, 5–7 by 6–7.5 by 7–8 mm, i.v. fleshy, pale greenish purple, i.s. blackish. *Putamens* 2, endocarp woody, brown, semi-globoid, tapering at base, apex splitting, c. 6 by 4–5.5 by 3–3.5 mm. *Seeds* semi-globoid with a lateral furrow, c. 3.5–5 by 4.5–5 by 2–2.5 mm, shining reddish black, rugulate.

Field notes — Bruised leaves of this species are smelling like *Annona* (*Schmutz 3349*, L, Flores).

Distribution — Burma, Thailand, Andaman & Nicobar Islands, N Malaya (Perlis, Lankawi, Penang), E Java, Lesser Sunda Islands (Bali, Sumbawa, Sumba, Flores, Alor, Timor). — Map 3.

Map 3. Distribution of *Bridelia ovata* Decne.

Fernandez-Villar (1880) mentions this species as seen in Luzon, Philippines. I cannot confirm its occurrence there and assume that he misinterpreted *B. tomentosa*. Koorders (1912) reports a record by Backer for W Java ('Batavia') which I cannot confirm either.

Habitat & Ecology — Reported from sandy beaches, savannahs, dry evergreen or deciduous forests and moist monsoon forests; on low altitudes (from sea level up to 400 m); on sandy or calcareous soil or limestone rocks; locally common.

Uses — Medicinal use of the leaves is reported several times, e.g., as a purgative (*van Beusekom & Santisuk 2728, L; Thailand*), against lues (syphilis) (*van Beusekom et al. 3398, L; Thailand*), and also for wrapping cigarettes (*Kerr 4419A, K, L; Thailand*).

Notes — 1. This species can be recognised by its rather large, broadly elliptic and chartaceous leaves with more than 14 pairs of secondary veins and the often conspicuous olive blackish colour in dry state. The branches and leaves are entirely glabrous and the latter are blunt on both ends. It seems to have a rather wide ecological range as the field notes prove. But the peculiar distributional pattern (from Burma and Thailand to the Lesser Sunda Islands, unknown from Sumatra) reveals it as requiring a strong (to severe) dry season. *Bridelia curtisii* is morphologically and ecologically similar, but distinguishable by having a narrow-oblong leaf-shape (index > 2), a

stiffly coriaceous texture, and less than 10 pairs of secondary veins. *Bridelia tomentosa* has much more slender and longer branches, and mostly smaller and apically acute leaves.

2. An exceptional trilocular fruit was observed in *Santisuk 556* (K) from Thailand whereas the other ones were normally bilocular.

3. The inclusion of Australia (Northern Territory) within the distributional range by Airy Shaw (1972) seems to go back to the unification of *B. exaltata* with *B. ovata*. No specimens could be traced and Australia is therefore omitted here. The occurrence in the Philippines stated by Fernández-Villars (1880) could not be confirmed and probably relies on a misidentification. Merrill [Enum. Philipp. Flow. Pl. 2 (1923) 424] excluded the species as well.

4. In the Index Kewensis *B. lanceolata* was erroneously reported to occur in Malaya, but in the protologue Java is cited.

5. The syntype of *B. burmanica* in the Wallich Herbarium represents *B. ovata* but has exceptionally large leaves with c. 20 pairs of secondary veins. However, the other syntype collected by Kurz clearly represents this taxon.

8. *Bridelia parvifolia* Kuntze

Bridelia parvifolia Kuntze, Rev. Gen. Pl. (1891) 594; Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 33; Jabl. in Engl., Pflanzenr. Heft 65 (1915) 63; Gagnep., Bull. Soc. Bot. France 70 (1923) 435, in obs.; in Lecomte, Fl. Indo-Chine 5 (1926) 496; Airy Shaw, Kew Bull. 23 (1969) 69; Pham-hoang Ho, Cayco Vietnam 2 (1992) 291. — Type: *Kuntze 3655* (NY holo; K iso), Anam, Tourane (= Tourane), March 1875.

Bridelia poilanei Gagnep., Bull. Soc. Bot. France 70 (1923) 434 (Airy Shaw, 1969, syn. nov.); in Lecomte, Fl. Indo-Chine 5 (1926) 490; P. T. Li, Acta Phytotax. Sin. 26 (1988) 64; Fl. Reipubl. Pop. Sin. 44 (1) (1994) 34. — Syntypes: *Poilane 2903* [K isosyn (s.n., but locality matching), P], Annam, Prov. Nha-trang, Ile de Tortue; *Poilane 2761* (n.v., probably P), Annam, Dong-bo; *Krempf s.n.* (n.v., prob. P), Annam, près Nha-trang.

Small shrub, 1–2(–3) m high, shortly and sparingly branched, often with very short internodes, of somewhat ‘spiny’ appearance. *Branches* glabrous throughout. *Stipules* early caducous, not seen (lanceolate to oblong-acuminate, 2–4 mm long, glabrous, ex Gagnepain, 1923: 434). *Leaves* comparatively small, petiole terete, glabrous, ribbed and black when dry, 2.5–6 mm long, c. 0.8 mm diam.; lamina oblong, sometimes slightly ovate or obovate, 16–64 by 13–43 mm, index (0.95–)1.2–1.9, stiffly chartaceous, base acute to rounded, rarely cordate, apex obtuse to rounded, margin entire, rarely faintly crenate where veins reach margin and i.s. slightly undulated. *Venation* faintly prominent on both sides, secondary veins in (5–)7–8(–9) pairs, arching and joining the marginal vein, sometimes branched near margin, tertiary veins irregularly reticulate or percurrent, but mostly not scalariform. *Indumentum* absent. *Inflorescence*: glomerules of 3–7(–9) sessile green flowers with several glabrous bracts. *Bracts* broadly ovate-triangular, 1–1.5 by 1–1.5 mm, with ciliate margin and thickly dark keeled (primary) vein. *Staminate flowers* 4–5 mm diam., pistillate flowers 5–7 mm diam. *Sepals* triangular, in staminate flowers c. 2 by 1–1.5 mm, in pistillate flowers 2–2.5 by 1.5–2 mm, glabrous. *Petals* very variable in shape, base cuneate to spatulate, apex roundish to lobulate, 0.8–1.2 by 0.6–1 mm, light with

darker spots. *Disc* glabrous, in staminate flowers 1.6–2 mm diam., outer one in pistillate flowers c. 2.5 mm diam., inner one annular, up to 0.5 mm long. Free part of *filaments* up to 1 mm long. *Anthers* shortly ellipsoid, 0.5–0.7 by 0.4–0.5 mm, staminal column c. 1 mm long, up to 0.4 mm diam., pistillode shortly ovoid to columnar with 2-lobed top, 0.6–1 mm long, c. 0.5 mm diam. *Ovary* depressed-semigloboid, c. 1.5 mm diam., styles c. 1.2 mm long, shortly bifid at apex, exerted in the flower. *Infructescence* with 1 or 2 fruits. *Fruit* compressed ovoid, slightly bilobate, pointed at apex, 6–7 mm long, diam. 4.5–6.5 mm, i.s. blackish. *Putamens* 2, endocarp brown, semigloboid, shallowly pointed on flat side, pointed at apex, 4.5 by 5.5 by 3 mm. *Seeds* semigloboid, deeply ventrally sulcate, 4 by 4.5 by 2 mm, pusticulate (if ever? only 1 seed examined), brown, embryo flat.

Distribution — Indochina, China (sec. Li, 1988).

Habitat — In dune thickets (according to collectors).

Notes — 1. This is the species with the smallest leaves in Asia, which are remarkably uniform in shape. They are glabrous, blunt, and slightly nigrescent and have only 6–8 pairs of secondary veins and a reticulate rather than a scalariform higher venation. With the marginal vein and the bilocular fruit it is clearly characterised as belonging to sect. *Scleroneurae*. The whole plant is typically glabrous in all parts and has a stout, dwarfy, xerophytic, somewhat ‘spiny’ appearance which corresponds well with its habitat.

2. I have seen only 5 collections.

9. *Bridelia retusa* (L.) A. Juss.

Bridelia retusa (L.) A. Juss., Euphorb. Gen. (1824) 109, t. 7, f. 22; Baill., Etude Euphorb. (1858) 584, Atlas t. 25, f. 25–34; [Arbor foliis latis subrotundatis nervosis subtus glaucis, spicis longis P. Herm., Mus. Zeyl. (1717) 27]; [Clutia foliis ovalibus petiolatis retusis, floribus racemosis sessilibus L., Fl. Zeyl. (1747) 175]. — *Clutia retusa* L., Sp. Pl. (1753) 1042; ed. 2 (1763) 1475; Willd., Sp. Pl. 4 (2) (1806) 883. — *Bridelia retusa* (L.) Spreng., Syst. Veg. 3 (1826) 48, pro comb. nov.; Thwaites, Enum. Pl. Zeyl. (1861) 279; Müll. Arg. in DC., Prodr. 15, 2 (1866) 493; Bedd., Fl. Sylv. S. India (1872) t. 260; Brandis, Forest Fl. NW India (1874) 449, t. 55 (illustrative fig.); Kurz, Prelim. Rep. For. Pegu, App. A: cix, App. B (1875) 78, in clavi; For. Fl. Burma 2 (1877) 368; Fern.-Vill. in Blanco, Fl. Philipp., ed. 3, Nov. App. 4 (1880) 186; Gamble, Man. Indian Timb. (1881) 595; Trimen, Syst. Cat. Flow. Pl. Ceylon (1885) 78; Hook. f., Fl. Brit. India 5 (1887) 268; G. Watt, Dict. Econ. Prod. India 1 (1889) 536; Kuntze, Rev. Gen. Pl. (1891) 594; Trimen, Handb. Fl. Ceylon 4 (1898) 10; Woodrow, J. Bomb. Nat. Hist. Soc. 12 (1899) 369; Boerl., Handl. Fl. Ned. Indië 3 (1900) 271; Prain, Bengal Pl. (1903) 927, repr. (1963) 694; Brandis, Indian Trees (1906) 560; Bourdillon, For. Trees Travancore (1908) 320; Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 30, 33; Talbot, For. Fl. Bombay 2 (1911) 435, f. 488; Craib, Kew Bull. (1911) 457; Aberdeen Univ. Stud. no. 57 (1912) 183; Jabl. in Engl., Pflanzn. Heft 65 (1915) 69; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 424 (as excluded spp.); Ridl., Fl. Malay Penins. 3 (1924) 184; Gagnep. in Lecomte, Fl. Indo-Chine 5 (1926) 487; Osmaston, For. Fl. Kumaon (1927) 473; Burkill, Dict. Econ. Pl. Malay Penins. (1935) 366; Merr., Pap. Michigan Acad. Sci. 24 (1939) 76; Talbot, Syst. List Trees Bombay, ed. 3 (1949) 442; Neal, Bernice P. Bishop Special Publ. 50 (1965) 504; Airy Shaw, Kew Bull. 23 (1969) 67; Kew Bull. 26 (1972) 230; Kew Bull. 36 (1981) 274; Grierson & Long, Fl. Bhutan 1 (3) (1987) 769; Pham-hoang Ho, Cayco Vietnam 2 (1992) 292; Saldanha, Fl. Marnataka 2 (1996) 123. — *Bridelia retusa* var. *genuina* Müll. Arg. in DC., Prodr. 15, 2 (1866) 493, nom. inval. — *Bridelia airy-shawii* P. T. Li, Acta Phytotax. Sin. 20 (1982) 117, nom. superfl.; Anon., Wealth

- of India 2B (1988) 295, f. 62 (instructive fig.). — Type: *Herb. Hermann 2: fol. 71, # 367* (BM lecto, here designated).
- Clutia squamosa* Lam., Encycl. 2 (1786) 54, syn. nov. — *Bridelia retusa* (L.) A. Juss. var. *squamosa* (Lam.) Müll. Arg. in DC., Prodr. 15, 2 (1866) 493; Hook. f., Fl. Brit. India 5 (1887) 268. — *Bridelia squamosa* (Lam.) Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 30; Haines, J. Bot. 59 (1921) 190; Anon., Wealth of India 2B (1988) 297. — *Bridelia squamosa* (Lam.) Gehrm. var. *typica* Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 30, nom. inval. — Type: *Hb. Sonnerat (P?)*; *Hb. Commerson (P?)* (n.v.), India oriental.
- Clutia spinosa* Roxb., Pl. Corom. 2 (1802) 38, t. 172. — *Bridelia spinosa* (Roxb.) Willd., Sp. Pl. 4 (1806) 979 (p. p., excl. specim. in B-W # 18957), non Hort. ex DC. (1833), non Wight (1852); Roxb., Hort. Bengal. (1814) 69; Spreng., Syst. Veg. 3 (1826) 48; Roxb., Fl. Ind., ed. Carey, 3 (1832) 735; J. Graham, Cat. Pl. Bombay (1839) 184; Voigt, Hort. Suburb. Calc. (1845) 155; Wall., Numer. List [1847 (1845?)] nr. 7883; P. T. Li, Acta Phytotax. Sin. 26 (1988) 63; Fl. Reipubl. Pop. Sin. 44 (1) (1994) 32, t. 9, f. 1–3 (instructive fig.). — Type: *Roxburgh s.n.* (Hb. Martius) (BR lecto, here designated; BM iso, # 19312, p. p.), s. loc.
- Bridelia amoena* Wall. ex Baill., Étude Euphorb. (1858) 584 (Müll. Arg., 1866: 493; syn. nov.); Voigt, Hort. Suburb. Calc. (1845) 156, nomen. — Type: *Wallich* in Hb. Gaudichaud (P?), Calcutta?
- Bridelia crenulata* Roxb., Hort. Bengal. (1814) 70, nomen; Fl. Ind., ed. Carey, 3 (1832) 734 (descr.) (Index Kewensis, syn. nov.). — *Bridelia retusa* var. *roxburghiana* Müll. Arg. in DC., Prodr. 15, 2 (1866) 493, nom. superfl. — *Bridelia roxburghiana* (Müll. Arg.) Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 30, nom. superfl.; Voigt, Hort. Suburb. Calc. (1845) 155; Hook. f., Fl. Brit. India 5 (1887) 268; Prain, Bengal Pl. (1903) 927, repr. (1963) 694. — Type: *Wallich 7880* [BM, G-DC n.v. (IDC microfiche in L), K, K-Wall], Botanic Garden Calcutta, from S. Harris anno 1798.
- Bridelia retusa* (L.) A. Juss. var. *glauca* Hook. f., Fl. Brit. India 5 (1887) 268, syn. nov. — Type not designated.
- Bridelia fordii* Hemsl., J. Linn. Soc. 26 (1894) 419, syn. nov.; P. T. Li, Fl. Reipubl. Pop. Sin. 44 (1) (1994) 34. — Syntypes: *Ford 249, 254* (K), China, Kwangtung, without locality.
- Bridelia retusa* (L.) A. Juss. var. *glabra* Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 30, syn. nov. — Type not designated.
- Bridelia retusa* (L.) A. Juss. var. *pubescens* Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 30, syn. nov. — Type not designated.
- Bridelia retusa* (L.) A. Juss. var. *stipulata* Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 30, syn. nov. — Type not designated.
- Bridelia squamosa* (Lam.) Gehrm. var. *meeboldii* Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 30, syn. nov. — Type not designated.
- Bridelia cambodiana* Gagnep., Bull. Soc. Bot. France 70 (1923) 432, syn. nov.; in Lecomte, Fl. Indo-Chine 5 (1926) 494, f. 62.12–16, 63.1. — Type: *Chaillon s.n.*, 9 Aug. 1909 (P lecto, here designated; P iso), Cambodge, Prey-kdey.
- Bridelia pierrei* Gagnep., Bull. Soc. Bot. France 70 (1923) 434, syn. nov.; in Lecomte, Fl. Indo-Chine 5 (1926) 494; Airy Shaw, Kew Bull. 23 (1969) 67; Kew Bull. 26 (1972) 229; Phamhoang Ho, Cayco Vietnam 2 (1992) 292; P. T. Li, Fl. Reipubl. Pop. Sin. 44 (1) (1994) 32. — Type: *Pierre 6287* (US lecto, here designated; BM, BO, BR, E, K, NY, P iso), Cambodia, Chaudoc, Mt Cam, Nov. 1867.
- Bridelia montana* auct. non Willd.: J. Graham, Cat. Pl. Bomb. (1839) 184; Wall., Numer. List [1847 (1845?)] nr. 7879, p. p.; Baill., Étude Euphorb. (1858) 583; Dalzell & A. Gibson, Bomb. Fl. (1861) 233

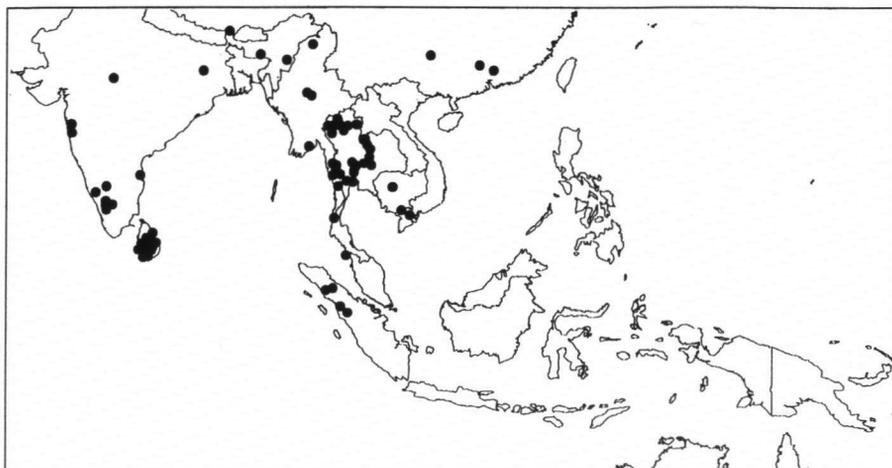
Medium to large-sized tree, up to 10(–20) m high, dbh up to 30 cm, rarely big shrub (3–4 m tall and wide), stems somewhat spiny. *Bark* dark brown to blackish, thick, roughly cracked, flaking in scales. *Branches* rusty tomentose to woolly when young, later pilose to glabrous. *Stipules* ovate triangular, to 2 mm long, 2 mm wide, whitish

woolly, early caducous. *Leaves*: petiole subterete, sparsely pilose, 7–12 mm long, c. 1–2.5 mm diam.; lamina elliptic, sometimes slightly obovate, 63–253 by 30–115 mm, index 1.4–2.7, stiffly (sub)coriaceous, base (acute to) obtuse to rounded, rarely subcordate, apex acute to obtuse, rarely emarginate, margin entire to shallowly crenate where veins reach margin. *Venation* prominent on both sides, conspicuously stronger below, secondary veins in (16–)19–23(–27) pairs, fairly straight to only slightly arching upwards, but often forking before joining the marginal vein, tertiary veins \pm patent to secondaries, simple or rarely forked percurrent, conspicuously scalariform. *Indumentum* light brownish, below pubescent to tomentose, rarely nearly glabrous, above glabrous, only at the midvein rarely pilose; leaves i.v. dark glossy green above, pale dull greenish, often glaucous beneath. *Inflorescence*: multibracteate glomerules of (3–)8–15 subsessile flowers on usually leafless branches [rarely small (up to 5 by 1 mm), woolly, thick, lanceolate leaves extant], hence of spike-like appearance, mostly terminal on twigs, sometimes also in axils of persisting normal leaves, ‘spikes’ often branched, up to 20 cm long, glomerules mostly of one sex only, but often both sexes in inflorescence. *Bracts* acuminate-triangular, 1.5–2 by 1.3–1.5(–2) mm, with dark and abaxially prominent midvein, pilose to tomentose. *Staminate flowers* 4–5 mm diam., pale yellow green to brown, *pistillate flowers* 5–5.5 mm diam., reddish to brown. *Pedicel* slender, up to 2 mm long. *Sepals* ovate-triangular, up to 1.7 by 0.8–1 mm in staminate, up to 2 by 1.2–1.5 mm in pistillate flowers, glabrous to pilose at base, rarely also at the apex. *Petals* variable in shape, base spatulate, apex roundish to lobulate with gnawed margin, whitish, 0.8–1.6 by 0.6–1 mm. *Disc* in staminate flowers 1.2–1.5 mm diam., yellow to pale orange, outer one in pistillate flowers up to 2.2 (in fruit 2.7) mm diam., inner one up to 1.6 mm long when conical-tubular. Free part of *filaments* c. 0.8–1 mm long, 0.1 mm diam., white. *Anthers* ovoid, c. 0.5–0.7 by 0.3–0.4 mm, reddish to purplish. *Staminal column* 1–1.3 mm long, 0.2–0.4 mm diam., *pistillode* narrow ovoid-conical, c. 0.7 mm long, 0.3–0.4 mm diam. *Ovary* globoid, apically tapering into style, 2-locular, 0.7–1.6 mm diam., 1–1.8 mm high, 2 styles 0.5–1 mm long, united below, shortly bifid above, stigmas papillose. *Infructescence* with 1–3 fruits. *Fruit* depressed-globose, sometimes apical bluntly pointed (remnant of style), sometimes bilobate, 5–8 mm long, 5–9 mm in diam., i.v. smooth, glossy, light green with minute pale greenish dots, ripening dark reddish, i.s. dark to bluish black. *Putamens* 2, semispherical, brown, woody to stony, 5 by 6 by 5 mm. *Seeds* semiglobular with ventral furrow, 4.5 by 5 by 3 mm; testa smooth, reddish brown.

Field notes — Trunk with scattered, up to 4 cm long, pointed thorns (*Kostermans 1461*, L); reported to be resistant to fire in regularly burnt grassy savannah (*de Wilde & de Wilde-Duyffes 18956*, L); before falling the leaves turn pinkish brown (Neal, 1965: 504); fruit are eaten by birds (pigeons) in India (*Koelz 29237*, L; Neal, 1965: 504).

Distribution — India, Sikkim, Bhutan, Sri Lanka, Burma, Indochina, S China, Thailand, Malay Peninsula (? see note 3), Sumatra. Fernandez-Villar’s (1880) report for the Philippines was already corrected by Merrill (1923). — Map 4.

Habitat & Ecology — Quite common in forests and open land, reported from dry evergreen or deciduous forests; sandy-loamy soil, granite or basalt derived sandy soil, and limestone; altitude 50–600(–1400) m.



Map 4. Distribution of *Bridelia retusa* (L.) A. Juss.

Uses — Cf. Wealth of India 2B (1988) 295. The dull red wood is used for construction, railway ties, fuel (Neal, 1965: 504), rafters, posts, and floor-boards; also used for cart-shafts, wheels and agricultural implements; suitable for tool-handles and helms (Useful Pl. India, 1986: 87). Bark contains tannin (16–40%); in pharmacological trials it exhibited antiviral, hypoglycaemic, hypotensive properties (Useful Pl. India, l.c.), used for tanning and medicinal (Burkill, 1935) and as a poison (Neal, l.c.). Leaves used as fodder (Useful Pl. India, l.c.), eaten by cattle, and said to free them from intestinal worms (Voigt, 1845; J. Graham, 1839: 184). Fruit edible (Useful Pl. India, l.c.), very adstringent (*Fernandes* 28, L).

Notes — 1. This species is identifiable by its spicate or sparsely branched, leafless or almost leafless, axillary inflorescences which can reach a length of 30 cm, and by its stiff-coriaceous leaves with 15–25 pairs of prominent secondary veins. Some similarities in leaf morphology exist with *B. macrocarpa* which, however, has its flower glomerules exclusively in the axils of normal leaves and develops big fruits.

2. Linnaeus described *Clutia retusa* based on material from Sri Lanka. Sprengel in 1826 was always considered to have made the combination in *Bridelia*. But Jussieu's older homonym *Bridelia retusa* is based on *Clutia retusa* sensu Willdenow (1806: 883) who cites Linnaeus' Sp. Pl. (ed. 2, 1763) and most of the Linnean sources. Hence Willdenow's concept is congruent with that of Linnaeus and both are homotypic. I have no idea why Müller Argoviensis in DC. (1866) synonymised Jussieu's name with *B. stipularis*. Hence, the selection of *B. airy-shawii* P.T. Li as a nomen novum is nomenclaturally superfluous.

3. I have no certainty about the occurrence on the Malay Peninsula as I have seen no recent collections. The records in the literature are based on one specimen cited by Ridley (1924), but Whitmore (1973) suspects this to be *B. stipularis*. However, Hooker (1887) already gave Malacca as part of the range, probably based on specimens from the Wight Herbarium (# 2602, 2604) which have no clear indication of the place of provenance (Peninsula Indiae Orientalis).

4. I saw three collections from the Hawaiian Islands, where the plant is obviously cultivated (cf. Neal, 1965: 504).

5. Willdenow made the new combination *Bridelia spinosa* based on Roxburgh (1802) but also cited material extant in B-W which represents *B. montana* Willd.

6. According to the leaf width and form, the indumentum, the shape of the inflorescences and the stipules several varieties were distinguished, but as these features are variable they are all united under *B. retusa*. In India plants with smaller, stiffer, more acute leaves are often to be found, which have been referred to as *B. squamosa*. These often stem from higher altitudes or drier localities. The material from Thailand often shows large leaves.

7. Airy Shaw regarded *B. pierrei* as closely related to but distinct from *B. retusa* due to its inflorescence structure (fewer flowers per inflorescence, persistent large stipules, etc.). All specimens determined by him as *B. pierrei* are in a very early stage of their inflorescence development and none is in anthesis or even fruiting. The stipules are still present and often the inflorescence axis is not yet grown out. A fruiting isosyntype in US has no persistent stipules.

8. *Bridelia cambodiana* was said to differ mainly by having the inflorescences on leaved branches which occurs sometimes in *B. retusa* as well. I subsume it under the latter as it perfectly matches otherwise.

10. *Bridelia stipularis* (L.) Blume — Fig. 1

Bridelia stipularis (L.) Blume, Bijdr. (1826) 597; Hassk., Cat. Hort. Bot. Bogor. (1844) 240; Baill., Étude Euphorb. (1858) 584; Miq., Fl. Ned. Indië 1, 2 (1859) 364; Fl. Ned. Indië, Suppl. (1861) 445; Müll. Arg. in DC., Prodr. 15, 2 (1866) 499; Miq., Ann. Mus. Lugd.-Bat. 4 (1869) 120; Bedd., Fl. Sylv. S. India, For. Man. (1873) 201; Brandis, Forest Fl. NW India (1874) 449; Kurz, For. Fl. Burma 2 (1877) 369; Fern.-Vill. in Blanco, Fl. Philipp., ed. 3, Nov. App. 4 (1880) 186; Gamble, Man. Ind. Timb. (1881) 596; S. Vidal, Sin. Gen. Pl. Leños. Filip. (1883) 38, Atlas t. 82 f. F.; Phan. Cuming. Philipp. (1885) 141; Rev. Pl. Vasc. Filip. (1886) 233; Hook. f., Fl. Brit. India 5 (1887) 270; Collett & Hemsley, J. Linn. Soc. 28 (1889) 122; G. Watt, Dict. Econ. Prod. India 1 (1889) 536; Kuntze, Rev. Gen. Pl. (1891) 594; Woodrow, J. Bomb. Nat. Hist. Soc. 12 (1899) 369; Boerl., Handl. Fl. Ned. Indië 3 (1900) 271; Talbot, Syst. List Trees Bombay, ed. 2 (1902) 298 (n.v.), ed. 3 (1949) 443; Prain, Bengal Pl. (1903) 928, repr. (1963) 694; Merr., Philipp. J. Sci. 1, Suppl. (1906) 78; Brandis, Indian Trees (1906) 560; Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 29; J.J. Sm. in Koord. & Valetton, Bijdr. Booms. Java 12 (1910) 315; Craib, Kew Bull. (1911) 457; Talbot, For. Fl. Bombay 2 (1911) 437, f. 489; Craib, Aberdeen Univ. Stud. No. 57 (1912) 183; Koord., Exk.-Fl. Java 2 (1912) 485, in clavi; Merr., Fl. Manila (1912) 284; F.C. Gates, Philipp. J. Sci., Bot. 9 (1914) 426; Jabl. in Engl., Pflanzenr. Heft 65 (1915) 55; Merr., Sp. Blanc. (1918) 220; Bibl. Enum. Born. Pl. (1921) 336; Enum. Philipp. Flow. Pl. 2 (1923) 424; Ridl., Fl. Malay Penins. 3 (1924) 183; S. Moore, J. Bot. 63, Suppl. (1925) 92; Gagnep. in Lecomte, Fl. Indo-Chine 5 (1926) 492; Osmaston, For. Fl. Kumaon (1927) 474; Hand.-Mazz., Symb. Sin. 7 (1931) 221; Merr. & Chun, Sunyatsenia 2 (1935) 264; Burkill, Dict. Econ. Pl. Malay Penins. (1935) 366; Gage, J. Asiat. Soc. Bengal. 75 (1936) 485; Corner, Wayside Trees Malaya, ed. 1 (1940) 243, ed. 2, 1 (1951) 243, ed. 3, 1 (1988) 279; Masamune, Enum. Phan. Born. (1942) 390; Backer & Bakh. f., Fl. Java 1 (1964) 475; Anon., Fl. Hainanica 2 (1965) 142; Meijer, Bot. News Bull. Forest Dept. Sabah 7 (1967) 39, in clavi; Corner & Watanabe, Ill. Guide Trop. Pl. (1969) 339; Airy Shaw, Kew Bull. 26 (1972) 230; Whitmore, Tree Fl. Malaya 2 (1973) 74, in clavi; Airy Shaw, Kew Bull., Add. Ser. 4 (1975) 65; Kew Bull. 36 (1981) 274; Kew Bull. 37 (1982) 11; Enum. Euphorb. Philipp. Isl. (1983) 11; Anon., Wealth of India 2B (1988) 296; Grierson & Long, Fl. Bhutan 1 (3) (1987) 769; Whit-

more, Tree Fl. Indon., Checkl. Kalimantan 1 (1990) 121; PROSEA (Lemmens & Wulijarni-Soetjipto, eds.) 3 (1992) 133; Pham-hoang Ho, Cayco Vietnam 2 (1992) 292; P. T. Li, Fl. Reipubl. Pop. Sin. 44 (1) (1994) 38, tab. 8, f. 5–7 (instructive fig.). — *Clutia stipularis* L., Mant. Pl. (1767) 127; Willd., Sp. Pl., ed. 4, 4 (2) (1806) 883 (as *Clutya*); Blanco, Fl. Filip. (1837) 818; ed. 2. (1845) 564, ed. 3, 3 (1879) 229 (as *Clutya*). — *Bridelia stipularis* (L.) Blume var. *typica* Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 29, nom. inval.; syn. nov. — Type: *LINN 1206.13* (LINN lecto, here designated, IDC microfiche in L).

Bridelia scandens (Roxb.) Willd., Sp. Pl. 4 (1806) 979 (Müll. Arg. in DC., 1866: 499, syn. nov.); Roxb., Hort. Bengal. (1814) 70; Spreng., Syst. Veg. 3 (1826) 48; Roxb., Fl. Ind., ed. Carey, 3 (1832) 736; J. Graham, Cat. Pl. Bombay (1839) 184; Voigt, Hort. Suburb. Calc. (1845) 156; Wall., Numer. List [1847 (1845?)] nr 7878 (excl. E); Baill., Étude Euphorb. (1858) 584; Dalzell & A. Gibson, Bomb. Fl. (1861) 233; Trimen, Syst. Cat. Flow. Pl. Ceylon (1885) 78; Handb. Fl. Ceylon 4 (1898) 11; Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 29; Jabl. in Engl., Pflanzenz. Heft 65 (1915) 55; Saldanha, Fl. Karnataka 2 (1996) 123. — [*Scherunam cottam* Rheed., Hort. Malab. 2 (1679) t. 16] (sec. Roxb., 1832; Dillwyn, Rev. Hort. Malab., 1839; Nicolson et al., Regnum Veg. 119 (1988) 107]. — *Clutia scandens* Roxb., Pl. Corom. 2 (1802) 39, t. 173. — Type: *Roxburgh s.n.*, s.d. (BR lecto, here designated; BM # 19310, K, K-Wall. # 7878A iso).

Bridelia zollingeri Miq., Fl. Ned. Indië 1, 2 (1859) 364 (Müll. Arg. in DC., 1866: 499, syn. nov.). — Type: *Zollinger 878* (erroneously cited as 8782 [U (fragm.) holo; P (sec. Müll. Arg., 1866: 499) iso], Java, Bandung).

Bridelia dasycalyx Kurz, J. Asiat. Soc. Beng. 42, ii (1874) 241 (Jabl., 1915: 56, syn. nov.); For. Fl. Burma 2 (1877) 369; Hook. f., Fl. Brit. India 5 (1887) 271; Brandis, Indian Trees (1906) 560; Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 29. — *Bridelia dasycalyx* var. *genuina* Kurz, nom. inval. — Type: *Kurz 1605* (K lecto, here designated; BO iso), Burma, Ava, Prome, Pegu.

Bridelia dasycalyx var. *aridicola* Kurz, J. Asiat. Soc. Beng. 42, ii (1874) 241 (Jabl., 1915: 56, syn. nov.); For. Fl. Burma 2 (1877) 369; Hook. f., Fl. Brit. India 5 (1887) 271. — Type: *Kurz 2475* (BO lecto, here designated), Burma, Brome, Pegu.

Bridelia montana auct. non Willd., nec Wall.: Woodrow, J. Bomb. Nat. Hist. Soc. 12 (1899) 369 (sec. J. J. Smith, 1910).

Bridelia stipularis (L.) Blume var. *ciliata* Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 29, syn. nov. — No type designated.

Bridelia stipularis (L.) Blume subsp. *philippinensis* Jabl. in Engl., Pflanzenz. Heft 65 (1915) 57, syn. nov. — Type: *FB 1884* (*Ahern's coll.*) (US # 851432 lecto, here designated; BO, K, NY iso), Philippines, Luzon, Prov. Rizal, Bosoboso, Oct. 1904.

Scrambling shrub (up to 16–20 m long) or small tree (up to 8 m high), branching sparingly or laxly and pendulous. Outer bark dark purple to brown, slightly flaking, inner bark pale green, soft, sapwood pale white. Branches young tomentose, velvety or woolly, later pilose. Stipules (narrow-)triangular to ovate, base rounded to truncate, rarely cordate, apex long-acuminate, 3–10 mm long, 2–4 mm wide, whitish to reddish brown pilose to velvety, caducous, but rather late. Leaves: petiole subterete, ± densely tomentose to velvety, 3–8(–9) mm long, c. 1(–1.8) mm diam.; lamina elliptic, sometimes ± ovate or obovate, 32–172 by 13–112 mm, index 1.2–2.6, chartaceous, base obtuse to rounded, sometimes slightly emarginate, rarely acute, apex mostly acute, also obtuse, rarely rounded, margin subentire to faintly crenate where veins reach margin and slightly undulated when dry. Venation prominent below, secondary veins in 9–13(–15) pairs, relatively straight, only very slightly arching and joining the marginal vein, tertiary veins ± patent to secondaries, simple or rarely forked percurrent, scalariform. Indumentum whitish, greenish, reddish, or brownish, pilose to villose above, densely tomentose to softly velvety below, at least at veins, otherwise pilose; leaves i.v. bright dark green above, lighter, greyish green,

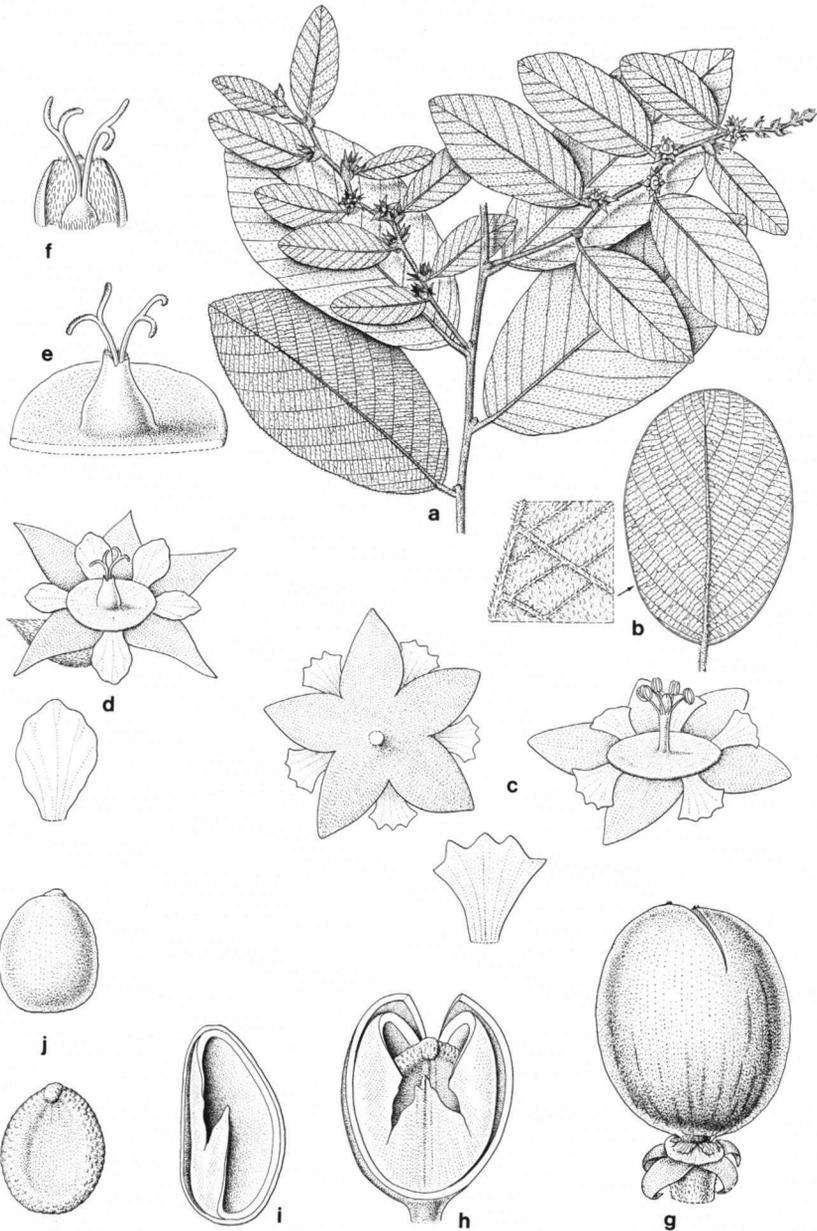
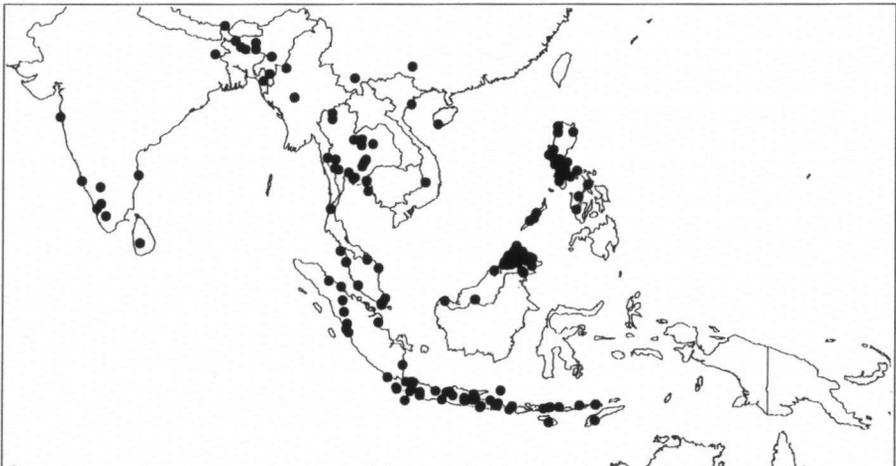


Fig. 1. *Bridelia stipularis* (L.) Blume. a. Habit, $\times 0.5$; b. leaf, $\times 0.5$, and detail of leaf margin (note fimbrial vein and pubescence); c. male flower, interior, from beneath, $\times 3$, and isolated petal*; d. female flower, $\times 3$, and isolated petal*; e. disc and styles of female flower, $\times 6$; f. tubular disc and ovary of female flower, $\times 6$ (note hairs at ovary base); g. fruit (note dehiscence); h. single valve with endocarp and seed; i. dehiscent endocarp; j. seed in ventral and dorsal view; g–h all $\times 3$ (a, d–f: Vidal 593; b, g: Maxwell 88-201; c: Merrill 551; h–j: van Beusekom 2960). Drawing by J.H. van Os (L. *) The isolated petals, $\times 6$, represent only two examples of the possible shapes.

often glaucous below. *Inflorescence*: glomerules of (1-)3-6 usually big (sub)sessile flowers set along the leafless or smaller-leaved ends of string-like twigs, each cluster with several woolly bracts. *Bracts* very variable in shape, broadly triangular to broadly ovate with apiculate apex, 3-4 by 3.5-4 mm, caducous in fruit. Staminate *flowers* cream to greenish or yellowish with purple anthers, 6-10 mm diam., pistillate flowers reddish green, up to 12 (in fruit 14) mm diam. *Pedicel* stout but short, c. 1 mm long, c. 2 mm diam., hairy. *Sepals* (acuminately) triangular, 4-5 by 2-3 mm, with variable indumentum from plain over base or apex hairy to densely tomentose, sometimes even adaxial. *Petals* very variable in shape, base cuneate to spatulate, apex roundish to lobulate, (1.5-)2-3 by (1-)1.5-2.5 mm. *Disc* in staminate flowers plain, 5-6 mm diam., outer one in pistillate flowers 4-6 mm diam., inner one 1.5 mm long, inside mostly hairy, hence after splitting a ring of hairs or hairy scales around fruit base. Free part of *filaments* c. 1.5 mm long, 0.1 mm diam. *Anthers* ellipsoid, purple, c. 1 by 0.5 mm. Staminal column c. 2 mm long, 0.5 mm diam., pistillode conico-ovoid with 2- or 4-merous top, c. 1 mm long, 0.5 mm diam. *Ovary* ovoid to globoid, 1.5-2 by 1.5-2 mm, styles 1.5-3 mm long, apex bifid (c. 1 mm). *Infructescence* with mostly 1 or 2, up to 5 fruits. *Fruit* ellipsoid to subglobose or ovoid, sometimes barrel-shaped, often bilobate, blunt to pointed at apex with remnants of style, 7-12 mm long, 6-11 mm in diam., i.v. glossy glaucous green with red dots, turning dull dark reddish to black, with fleshy mesocarp splitting between 2 *putamens*. Endocarp horny, light brown, splitting loculicidally from apical, fruit finally leaving receptacle with persistent sepals, petals, hairy disc-scales, and columella-like structure. *Seeds* semiovoid, dorsally keeled, ventrally sulcate, subapical hilum, 6-7 by 3-5.5 by 2-3.5 mm, shiny, striate, reddish brown; embryo flat; cotyledons obovate, simply folded; endosperm thin.

Distribution — Sri Lanka, India, Nepal, SE Asia mainland, Malay Peninsula, Sumatra, Java, N Borneo, Philippines (unknown from Mindanao), Lesser Sunda Islands (Bali, Lombok, Sumba, Flores, Alor, Timor). — Map 5.



Map 5. Distribution of *Bridelia stipularis* (L.) Blume.

Habitat & Ecology — Primary and secondary forests, often near wet places (rivers, swamps, seashore, mangrove); mostly reported from sandy soil, but also from limestone or loamy soil above igneous rocks; from sea level up to 400(–1100) m altitude.

Uses — Cf. Wealth of India 2B (1988) 296. The plant is said to be poisonous [Airy Shaw, 1975, *BNB For. Dept.* 2354 (leg. Maidin), Borneo]. Twigs used for basketry (Useful Pl. India, 1986: 87). Bark used as medicine against intestinal worms (*Hohenacker, Pl. Indiae Or.* 345, L) and for tanning [PROSEA 3 (1992) 133]. Decoction of bark used for cough, fever, and asthma; also shows hypotensive hypoglycaemic action on animals (Useful Pl. India, l.c.). Leaves medicinal (cf. Burkill, 1935), infusion of the leaves against colic on Java in the vicinity of Bogor [K. Heyne, *Nutt. Pl. Ned. Ind.*, ed. 3 (1950) 918], used for jaundice (Useful Pl. India, l.c.). Fruits are said to be edible (Airy Shaw, 1975; Useful Pl. India, l.c.; Borneo: *Cuadra A264, BNB For. Dept.* 2662) and to produce a sticky fluid when wounded (*van Beusekom et al.* 4420, Thailand) and to yield a black colouring matter (PROSEA, l.c.). Seeds possess hemagglutinating properties and yield a fatty oil (Useful Pl. India, l.c.).

Notes — 1. The leaves are very variable in size and shape; those subtending inflorescence clusters are often smaller and shorter petioled. There are many collections with obovate leaves from the Lesser Sunda Islands and with subrotundate ones from Thailand. Nevertheless, the species is easily recognisable by its abaxially tomentose to velvety leaves having only 9–14 pairs of secondary veins. Other diagnostic characters comprise the relatively large flowers (up to 12 mm diam.) with the hairy inner disc in the pistillate ones and the large, often barrel-shaped, dehiscent fruits (only the fruits of *B. macrocarpa* are bigger) as well as the scrambling habit.

2. Some collections, mostly from the Asian mainland, lack the hairs inside the inner pistillate disc and hence the hairy ring at the fruit base. *Bridelia scandens* was based mainly on this feature (beside a generally more delicate appearance, smaller leaves and flowers, and differing indumentum of the sepals, cf. Jablonszky, 1915). Nearly all these collections are very variable and intergrading, and, e.g. in Thailand, both character states of disc hairiness occur together so that I agree with all previous authors who considered both taxa to be conspecific.

3. I place *B. stipularis* subsp. *philippinensis* into synonymy under the species as I cannot observe any distinction of the Philippine material, neither in indumentum nor in leaf size, from specimens collected elsewhere. Both these characters are extremely variable.

4. Globose galls on the lower leaf surface are often found; they are resembling valvate flower buds, up to 5 mm diam.; cf. Docters van Leeuwen-Reijnvaan, *Marcellia* 8 (1909) 89 (sec. Jablonszky, 1915: 57).

5. *Pseudococcus virgatus* (Cockerell) – Coccidae – a mealy bug was found on this species in Luzon, Manila, Malate, April 1917 [Philipp. J. Sci., D, 13 (1918) 146].

11. *Bridelia tomentosa* Blume — Fig. 2

Bridelia tomentosa Blume, *Bijdr.* (1826) 597; Hassk., *Cat. Hort. Bot. Bogor.* (1844) 240; Wall., *Numer. List* [1847 (1845?)] nr 7874; Benth., *Hook. J. Bot. Kew Gard. Misc.* 6 (1854) 8; Seem., *Bot. Voy. Herald* (1857) 410; Baill., *Étude Euphorb.* (1858) 584; Hook. f., *Fl. Tasman.* (1859) xlvii; Miq., *Fl. Ned. Indië* 1, 2 (1859) 364; *Fl. Ned. Indië, Suppl.* (1861) 445; Benth., *Fl. Hongk.*

(1861) 309; Müll. Arg. in DC., Prodr. 15, 2 (1866) 501; Benth., Fl. Austral. 6 (1873) 120; Kurz, Prelim. Rep. For. Pegu (1875) App. A: cix., App. B.: 78, in clavi; For. Fl. Burma 2 (1877) 367; Fern.-Vill. in Blanco, Fl. Philipp., ed. 3, Nov. App. 4 (1880) 186; Gamble, Man. Ind. Timb. (1881) 596; S. Vidal, Rev. Pl. Vasc. Filip. (1886) 234; Hook. f., Fl. Brit. India 5 (1887) 271; G. Watt, Dict. Econ. Prod. India 1 (1889) 537; Kuntze, Rev. Gen. Pl. (1891) 594; Forbes & Hemsl., J. Linn. Soc. 26 (1894) 419; Henry, List Pl. Formos. (1896) 82 (= Trans. Asiat. Soc. Japan 24, Suppl.: 82); Boerl., Handl. Fl. Ned. Indië 3 (1900) 271; F.M. Bailey, Queensl. Fl. 5 (1902) 1411; Prain, Bengal Pl. (1903) 928, repr. (1963) 694; Hayata, J. Coll. Sci. Tokyo 20 (1904) 30, t. 3A; Matsum. & Hayata, J. Coll. Sci. Tokyo 22 (1906) 362; Brandis, Indian Trees (1906) 560; Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 32; J.J. Sm., Nova Guinea 8 (1910) 231; in Koord. & Valetton, Bijdr. Booms. Java 12 (1910) 320; Ridl., J. Straits Branch Roy. Asiat. Soc. 59 (1911) 167; Craib, Kew Bull. (1911) 457; Aberdeen Univ. Stud. No. 57 (1912) 183; Koord., Exk.-Fl. Java 2 (1912) 485, in clavi; Jabl. in Engl., Pflanzenz. Heft 65 (1915) 58, f. 11A; W. Fitzg., J. Proc. Roy. Soc. W. Austral. 3 [1918 (1916–1917?)] 163; Merr., Bibl. Enum. Born. Pl. (1921) 336; Ridl., Fl. Malay Penins. 3 (1924) 184; S. Moore, J. Bot. 63, Suppl. (1925) 92; Gagnep. in Lecomte, Fl. Indo-Chine 5 (1926) 488; Gage, J. Asiat. Soc. Bengal. 75 (1936) 487; M.R. Hend., J. Malayan Br. Roy. As. Soc. 17 (1939) 69; Corner, Gard. Bull. Str. Settle. ser. 3, 10 (1939) 291; Corner, Wayside Trees Malaya, ed. 1 (1940) 243, ed. 2, 1 (1951) 243, f. 72, ed. 3, 1 (1988) 280, f. 78; Masam., Enum. Phan. Born. (1942) 390; F.G. Browne, For. Trees Sarawak (1955) 177; Corner & Watanabe, Ill. Guide Trop. Pl. (1969) 338; Airy Shaw, Kew Bull. 26 (1972) 231; Kew Bull., Add. Ser. 4 (1975) 65; Kew Bull. 31 (1976) 382; Hsieh, Fl. Taiwan 3 (1977) 452; ed. 2, 3 (1993) 430; Airy Shaw, Kew Bull., Add. Ser. 8 (1980) 45; Kew Bull. 35 (1980) 602; Muellera 4 (1980) 223; Kew Bull. 36 (1981) 274; Kew Bull. 37 (1982) 11; Enum. Euphorb. Philipp. Isl. (1983) 11; Grierson & Long, Fl. Bhutan 1 (3) (1987) 770; P.T. Li, Acta Phytotax. Sin. 26 (1988) 64; Anon., Wealth of India 2B (1988) 297; Whitmore, Tree Fl. Indon., Checkl. Kalimantan 1 (1990) 121; Hnatiuk, Austral. Fl. Fauna Ser. 11 (1990) 180; Chapman, Austral. Fl. Fauna Ser. 12 (1991) 477; P.T. Li, Fl. Reipubl. Pop. Sin. 44 (1) (1994) 30, 31, t. 8, f. 1–4 (instructive fig.). — Type: *Blume s.n.* (BO lecto, designated by Airy Shaw, Kew Bull. 35, 1980; BM, BR, L, NY iso), Java, Buitenzorg (Bogor).

Bridelia loureirii Hook. & Arn., Bot. Beechey Voy. (1837) 211, excl. syn. Lour. (Müll. Arg. in DC., 1866: 501, syn. nov.).

?*Bridelia urticoides* Griff., Not. Pl. Asiat. 4 (1854) 481 (sec. Index Kewensis). — Type: *Griffith* (not traced, CAL?), Burma, Mergue, ad littoram Ins. Madamaca, Dec. 1834.

Bridelia monoica sec. Merr., Philipp. J. Sc., Bot. 13 (1918) 142. — vix *Clutia monoica* Lour. (sec. Corner, 1939: 291f.); Merr., Enum. Philipp. Flow. Pl. 2 (1923) 423; Lingnan Sci. J. 5 (1927) 109, n.v.; Trans. Amer. Philos. Soc. II, 24 (2) (1935) 234; Burkill, Dict. Econ. Pl. Malay Penins. (1935) 365; Kanehira, Formosan Trees (1936) 333, f. 287; K. Heyne, Nutt. Pl. Ned. Indië, ed. 3 (1950) 918; Keng, Taiwania 6 (1955) 38; H.L. Li, Woody Fl. Taiwan (1963) 419; Salvosa, Lex. Philipp. Trees (1963) 89; Backer & Bakh. f., Fl. Java 1 (1964) 475, in clavi; Anon., Fl. Hainanica 2 (1965) 142, f. 365; Airy Shaw, Kew Bull. 26 (1972) 228, 231, in clavi; Whitmore, Tree Fl. Malaya 2 (1973) 74, in clavi; Pham-hoang Ho, Cayco Vietnam 2 (1992) 290.

Erect to scrambling shrub or small tree, up to 13 m high, to 15 cm dbh, bark smooth to slightly roughened, inner bark pink. *Branches* very slender, often long and whip-like, scrambling, spreading or drooping, glabrous to tomentose, with scattered lenticels, old branches sometimes thorny. *Stipules* early caducous, ovate to narrow-triangular, sometimes aristate at apex, pubescent to tomentose, 2–4(–5) mm long, c. 1 mm wide at base. *Leaves* often rather small, petiole terete, glabrous to tomentose, (2–)3–5.5 mm long, 0.8–1.5 mm diam.; lamina elliptic-lanceolate to -obovate, 25–140 by 10–60 mm, index mostly > 2, (1.7–3.7), thinly chartaceous, base obtuse,

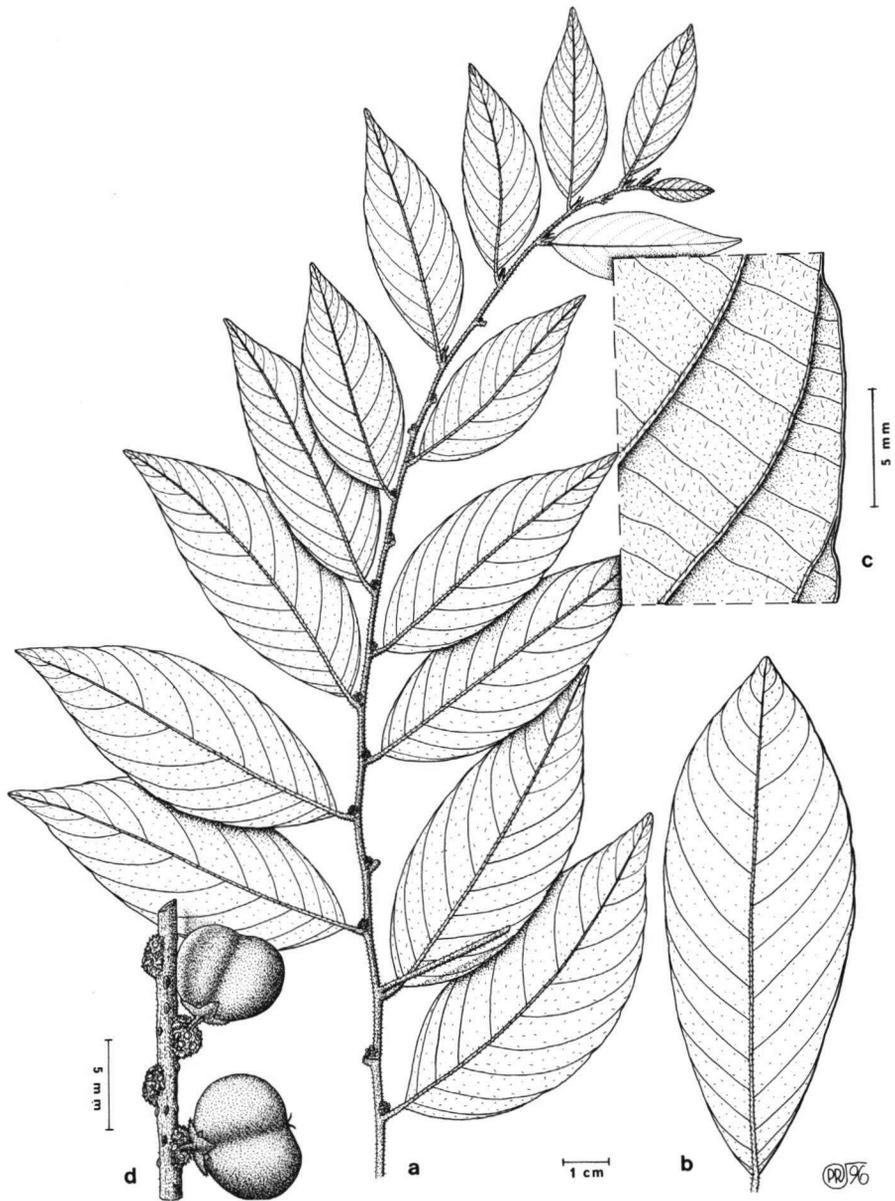


Fig. 2. *Bridelia tomentosa* Blume. a. Habit; b. leaf; c. detail of leaf margin (note fimbrial vein); d. part of fruiting twig (a–c: Ambri & Arifin AA 1079, WAN; d: Dressler s.n., Singapore, WAN). Drawing by Priyono (WAN).

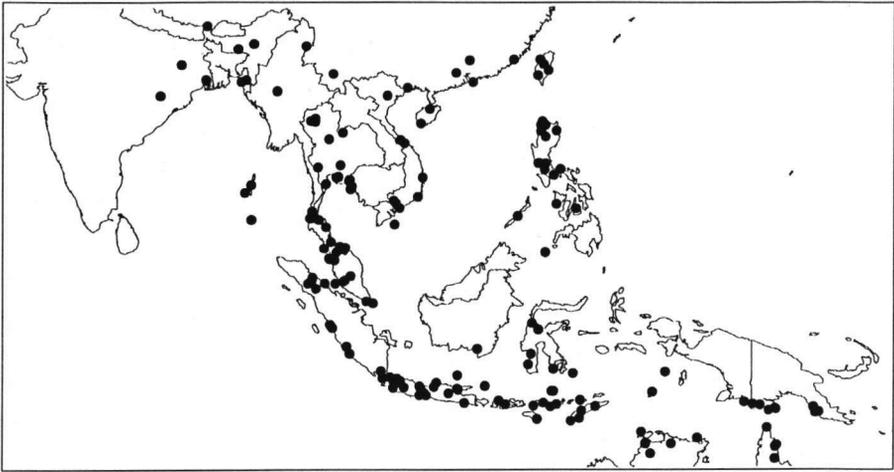
rarely acute, apex (bluntly) acute, rarely short-acuminate, margin entire, rarely shallowly crenate where lateral veins reach the margin. *Venation* (weakly) prominent, secondary veins in 7–12(–15) pairs, continuously arching and joining the marginal vein, tertiary veins percurrent, irregularly scalariform, irregular reticulate areolation. *Indumentum* glabrous to tomentose, in the latter case also adaxially scattered, appressed hairs and pubescent on the main nerves; leaves dull dark green above, dull green to whitish green beneath, i. s. often conspicuously glaucous. *Inflorescence*: small multibracteate glomerules of up to 10(–20) sessile green flowers. *Bracts* broadly triangular, up to 0.7 by 0.5 mm, puberulous, with ciliate margin. *Staminate flowers* 2–3 mm diam., *pistillate flowers* 3–4 mm diam., sessile, rarely with up to 1 mm long glabrous stalk, if so pistillate flowers stouter stalked than staminate ones. *Sepals* triangular, 0.8–1.2 by 0.5–0.8 mm in staminate, 1.2–1.5 by 0.8–1.2 mm in pistillate flowers, glabrous, greenish yellow. *Petals* very variable in shape, base cuneate to spatulate, apex roundish, notched or lobulate, up to 1 by 0.8 mm, whitish yellow. *Disc* glabrous, in staminate flowers 1–1.2 mm diam., outer one in pistillate flowers c. 2.2 mm diam., inner one tubular, up to 0.6 mm long, covering $\frac{3}{4}$ of the ovary, margin sometimes erose. Free part of *filaments* up to 0.5 mm long. *Anthers* shortly ellipsoid, 0.4–0.5 by 0.3–0.4 mm. *Staminal column* c. 0.7 mm long, *pistillode* conical-ovoid, up to 0.4 mm long, c. 0.2 mm diam. *Ovary* globoid, c. 1 mm diam., style from the base divided into 2 arms, very short, to 0.5 mm long, stigma lobed. *Infructescence* with up to 7 fruits. *Fruit* (sub)globoid, sometimes depressed and laterally compressed, emarginate at apex, slightly bilobate, 4.5–6.5 mm diam., i. v. fleshy, greenish to blue, i. s. blackish. *Putamens* 2; endocarp woody, brown, semi-globoid, apically splitting, c. 4 by 5 by 2.5 mm. *Seeds* semigloboid to broadly semi-tear-shaped, with deep lateral furrow, c. 3–3.5 by 4 by 2–2.5 mm, brown, rugulate.

Field notes — Flowers scented (sec. coll.), faint musty smell, crown full of butterflies (FRI 13000, L, Malacca).

Distribution — India (Madras, Bengal, Assam-Khasi Hills, Bihar, Orissa), E Nepal, Sikkim, S China, Hainan, Taiwan, Burma, Indochina, Thailand, Andaman (Middle and South) and Nicobar Islands, Malay Peninsula, Sumatra, Java, Borneo (SE Kalimantan), Philippines (unknown from Mindanao), Celebes, Lesser Sunda Islands (Sumbawa, Sumba, Flores, Alor, Timor), Moluccas (Tanimbar & Kei Is.), New Guinea, N Australia; common throughout its range, but rare in Borneo (only known from the SE corner). — Map 6.

Habitat & Ecology — Deciduous to evergreen forests, primary to secondary vegetation; reported from sandy or loamy soil, limestone, and over granite bedrocks; altitude from sea level up to 1000 m. Reported to be rather common on waste land and in secondary forests (Browne, 1955: 177, Corner, 1988: 280).

Uses — Cf. Wealth of India 2B (1988) 297. Timber tree: wood suitable for baskets, carts, wheels, and tool-handles (Heyne, 1950: 918; Useful Pl. India, 1986: 87), for report of wood quality cf. Browne (1955: 177), for chemical compounds of the stem cf. Wealth of India, l. c. Tannin-producing plant: bark astringent, used in colic, also for tanning (Useful Pl. India, l. c.), used to colour wood black (*Meijer 5363*, L, Sumatra). Infusion of leaves against colic (Heyne, l. c.). Fruits eaten (Useful Pl. India, l. c.). Seeds used by children for bullets in bamboo guns (*Hu 5013*, K). Well known in village medicine, in folk tales (cf. Corner, 1988: 280).

Map 6. Distribution of *Bridelia tomentosa* Blume.

Notes — 1. The characteristic features of this variable and widespread species comprise the long, slender, often whip-like branches, the elliptic, rather small and narrow, pointed leaf with conspicuous whitish glaucous undersurface, the small (mostly < 10 flowers) inflorescences and the the small flowers (staminate 2–3 mm, pistillate 3–4 mm diam.).

2. The present species forms, together with *B. curtisii* and *B. harmandii*, a species complex which is often difficult to disentangle. The main differences from *B. curtisii* are the acute to acuminate leaf tip, the often glaucous undersurface of the leaf, its weaker texture, as well as the smaller flowers. *Bridelia curtisii* shows a rather distinct leaf shape. Nevertheless intergrading specimens occur (e.g., *Lörzing 16248*, L, Sumatra). *Bridelia harmandii*, which occurs in Thailand and Indochina, differs in its stiffer coriaceous, rather broad leaves, an always strong indumentum in many parts (also outside the calyx), rather persistent subulate stipules, and less flowers per glomerule.

3. Within the area studied a considerable variation could be found in the indumentum of the leaves and to a lesser extent in the leaf shape. Such a diversity is not very surprising within such a widespread and ecologically adaptable species. In the Philippines an accumulation of absolutely glabrous plants could be observed. This glabrous form is referred to as *B. tomentosa* var. *glabrescens* Benth. and together with the type variety these are the only infraspecific taxa which could be observed in Indochina and Malesia (see below). The varieties *trichadenia* Müll. Arg. and *eriantha* Airy Shaw are so far only known from Australia (Northern Territory) (Airy Shaw, Kew Bull. 35, 1980).

4. One aberrant trilocular fruit was seen (*Mizushima & Liao 10885*, L, Taiwan). Such an exception occurs rarely in several species of the genus (cf. however *B. triplocarya*) and was already reported for *B. tomentosa* by Hooker & Arnott (1837: 211; under *B. loureirii*).

5. The fact that the widespread *B. tomentosa* was not collected in Borneo (except in the very Southeast: *Motley 493*; *Winkler 2635, 2965, 2973, 3023*; *Ambri & Arifin AA 1079*) seems worth mentioning and could be explained by the relatively drier climate there. In New Guinea the species is apparently ranging only in the South as well. *Bridelia tomentosa* is obviously a plant showing a seasonal drought pattern of distribution (see the section Biogeography).

This species is represented in Southeast Asia by two varieties (a. var. *tomentosa* and b. var. *glabrescens*) which are widespread all over the area. The latter variety is characterised by lacking an indumentum (especially on the undersurface of the leaf) and is found all over the range of the species. As Airy Shaw (1976: 383) already pointed out, intermediate forms with minute traces of pubescence do occur.

a. var. *tomentosa*

- Bridelia tomentosa* var. *genuina* Müll. Arg. in DC., Prodr. 15, 2 (1866) 501, nom. inval. — *Amanoa tomentosa* (Blume) Baill., Adansonia 6 (1866) 336.
- Bridelia lancifolia* Roxb., [Hort. Bengal. (1814) 70, nom. nud., orth. var. (*lanceifolia*)] Fl. Ind. ed. Carey, 3 (1832) 737 (*lancaefolia*); Wall., Numer. List [1847 (1845?) nr. 7884; Airy Shaw, Kew Bull. 26 (1972) 231, orth. var. (*lanceifolia*); Kew Bull., Add. Ser. 4 (1975) 65; Kew Bull., Add. Ser. 8 (1980) 45. — Type: *Roxburgh s.n.* (BM lecto, here designated; K iso).
- Bridelia rhamnoides* Griff., Not. Pl. Asiat. 4 (1854) 480 (Müll. Arg. in DC., 1866: 501, syn. nov.). — Type: *Griffith s.n.* (K, CAL n.v.), Burma, in sylvis Mergue, Oct. 1834.
- Bridelia tomentosa* Blume var. *rhamnoides* Müll. Arg. in DC., Prodr. 15, 2 (1866) 502. — Type: *Hoffmannsegg s.n.* [B, destr. & in hb. Franquev. (P?)], fragm. G-DC (IDC microfiche in L), Java.
- Bridelia tomentosa* Blume var. *chinensis* Müll. Arg. in DC., Prodr. 15, 2 (1866) 501 (P.T. Li, 1994: 30, syn. nov.). — Syntypes: *Park s.n.* [G-DC n.v. (IDC microfiche in L)], China; *Motley 493* (K), Borneo prope Bangarassing.
- Bridelia tomentosa* Blume var. *ovoidea* Benth., Fl. Austral. 6 (1873) 120 (Airy Shaw, 1976: 382, syn. nov.). — Type: *Gulliver s.n.* (K holo), Australia, Northern Territory, Wood Island.
- Bridelia phyllanthoides* W. Fitzg., J. Proc. Roy. Soc. W. Austral. 3 (1918) 163 [Airy Shaw, Muelleria 4 (1980) 223, syn. nov.]. — Type: *Fitzgerald 823* (NSW n.v.), W Australia, base of Mt Broome, 1905.

b. var. *glabrescens* Benth.

- Bridelia tomentosa* Blume var. *glabrescens* Benth., Hook. J. Bot. Kew Gard. Misc. 6 (1854) 8. — Type: *Champion s.n.* (K?), Hongkong, East Point, Hedges.
- Bridelia glabrifolia* Merr., Enum. Philipp. Flow. Pl. 2 (1923) 422; Salvosa, Lex. Philipp. Trees (1963) 88. — *Bridelia tomentosa* Blume var. *glabrifolia* (Merr.) Airy Shaw, Kew Bull. 31 (1976) 383. — *Bridelia tomentosa* var. *lancaefolia* sec. Müll. Arg. in DC., Prodr. 15, 2 (1866) 502, non *Bridelia lanceaefolia* Roxb. — *Bridelia lancaefolia* [sic!] sec. Jabl. in Engl., Pflanzenr. Heft 65 (1915) 60, non *Bridelia lanceaefolia* Roxb. — Type: *Gaudichaud s.n.* (G-DC n.v., lecto, designated by Airy Shaw, Kew Bull. 35, 1980), Philippines, Manila.
- Bridelia ovata* auct. non Decne.: Benth., Fl. Austral. 6 (1873) 120; Jabl. in Engl., Pflanzenr. Heft 65 (1915) 61 (sec. Airy Shaw, 1976: 383.)

Note — The first description of a glabrous form of *B. tomentosa* has unfortunately been overlooked, so that the commonly known name (var. *glabrifolia*) has to be changed to var. *glabrescens*. The type could not be traced in Kew.

12. *Bridelia triplocarya* Airy Shaw

Bridelia triplocarya Airy Shaw, Kew Bull. 32 (1978) 385; Kew Bull., Add. Ser. 8 (1980) 45. —

Type: Schodde 2768 (K holotype; BO, CANB n.v., E, L, SING iso), Papua, Central Distr., 1.5 km N of Rigo, alt. 15 m, 13 Aug. 1962.

Slender tree (c. 7 m high), dbh c. 8 cm. Outer bark dark grey, rough, furrowed, wood pink cream outside, dark brown inside. Branches slender, scattered pilose to puberulous. Stipules early caducous, narrow-triangular, subulate, c. 3 mm long, 0.3 mm wide at base, whitish puberulous. Leaves: petiole subterete, scabrous to sparsely puberulous, 4–8 mm long, c. 0.7–1.3 mm diam.; lamina elliptic, 4–11 by 1.5–4.5 cm, index 1.9–3, coriaceous, base acute to obtuse, apex acute, sometimes obtuse, margin entire to rarely distantly shallowly crenate where veins reach margin. Venation prominent on both sides, stronger below, secondary veins in 10–14 pairs, steeply ascending, fairly straight, only slightly arching, but often forking before joining the fimbrial vein, tertiary veins irregular percurrent, simple or rarely forked, sometimes scalariform, reticulate areolation. Indumentum below inconspicuously light puberulous to pubescent, above completely glabrous; leaves i.v. slightly glossy green above, pale green, almost glaucous beneath. Inflorescence: paucibracteate glomerules of 2–5 sessile flowers. Bracts (depressed) triangular, tiny, up to 0.8 by c. 1 mm, whitish pilose to puberulous. Staminate flowers not seen, pistillate flowers 4–5 mm diam. in fruit. Pedicel indistinct, up to 0.5 mm long. Sepals triangular, 1.4–1.8 by c. 1.3 mm in pistillate flowers, glabrous. Petals variable in shape, base spatulate, apex roundish, triangular to lobulate with gnawed margin, 0.7–1 by 0.5–0.7 mm. Scales of inner disc in pistillate flowers 1–1.5 mm long. Ovary not seen. Infructescence with 1 or 2 almost sessile fruits, up to 0.5 mm stalked. Fruit globose, 8–9 mm long, 6–8 mm diam., (2- or) 3-locular, i.v. smooth, dull pink maroon, i.s. bluish black, glaucous, conspicuously stipitate (1–2 mm) by tapering fruit base and often 6–9-ribbed. Putamens of the shape of a spherical segment with acute base, ventrally carinate, dorsal with costa, margin erosely winged, c. 6.5 by 8 by 3.5 mm. Seeds flat-semigloboid, plano-convex with shallow ventral furrow, base subacutely tapering, c. 3.5–4 by 4–5 by 1–1.5 mm; testa reddish brown.

Distribution — New Guinea, so far only known from the type collection (Map in Dressler, 1996b: 601).

Habitat & Ecology — Monsoon hill forest, at c. 15 m altitude.

Notes — 1. *Bridelia triplocarya* usually has trilocular fruits, which is very unusual in the genus. Exceptionally, fruits with three locules can be found in some other species (e.g., *B. ovata*, *B. macrocarpa*), but normally they are characteristic for *Cleistanthus* where they are developed as fully dehiscent woody capsules. Although *B. triplocarya* shows three locules it is clearly a *Bridelia* because of its indehiscent drupes with copious fleshy mesocarp. A fimbrial vein is also not found in *Cleistanthus*.

Apart from the fruit this species is characterised by the stiffly coriaceous leaves which are puberulous beneath and show a prominent venation on both sides. It seems to be a very rare endemic in New Guinea.

2. This taxon seems to have some affinities with *B. macrocarpa* and *B. erapensis*, both from New Guinea. In the former species trilocular fruits are occasionally found, but these have plum-like dimensions. The leaves are larger and have more secondary

vein pairs. They have normally only a pilose indumentum beneath. Also the inflorescences are much larger, with 8–16 flowers. The latter species, however, has ovate leaves with an often cordate base, and bilocular fruits.

3. In leaf shape and the number of fruits per infructescence there is a superficial resemblance between *B. triplocarya* and *B. exaltata* from E Australia as Airy Shaw already noted. But the venation pattern, the leaf texture, and the fruits clearly distinguish both taxa.

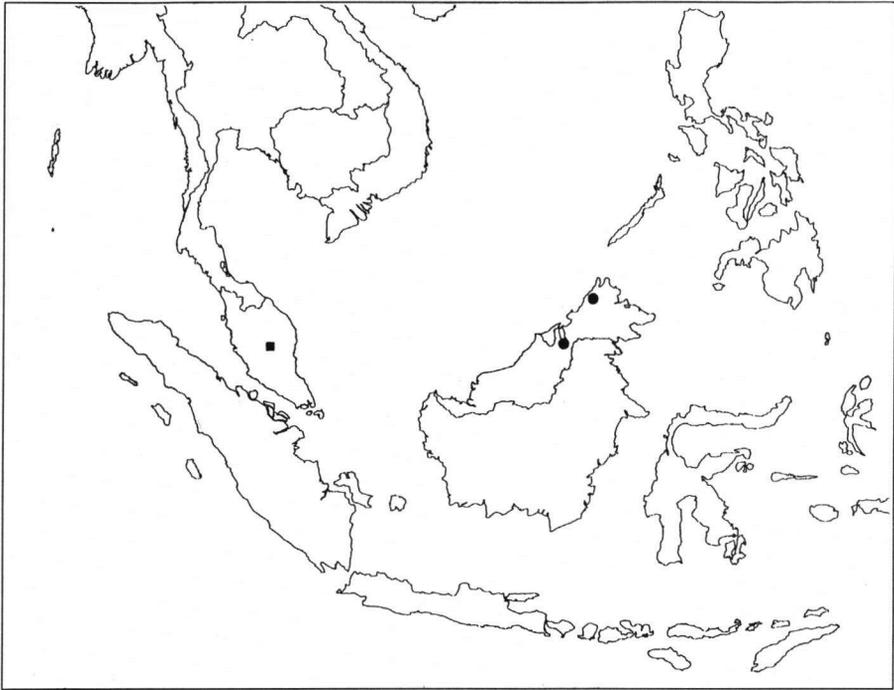
Subgenus *Gentilia*

Bridelia subg. *Gentilia* (Beille) Jabl. in Engl., Pflanzenr. Heft 65 (1915) 71. — *Gentilia* Beille, Compt. Rend. Hebd. Séances Acad. Sci. 145 (1907) 1294. — *Bridelia* sect. *Monospermae* Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 12. — *Bridelia* sect. *Gentilia* (Beille) Gehrm., Jahresber. Schles. Ges. Vaterl. Cult. 1908 (1909) 28, nom. superfl. — Type species: *Gentilia hygrophila* Beille (= *Bridelia ndellensis* Beille) (lectotype, designated by Webster, 1994: 39).

13. *Bridelia adusta* Airy Shaw

Bridelia adusta Airy Shaw, Kew Bull., Add. Ser. 4 (1975) 224; Kew Bull., Add. Ser. 4 (1975) 63; Kew Bull. 32 (1978) 383; Anderson, Checkl. Trees Sarawak (1980) 179; Whitmore, Tree Fl. Indon., Checkl. Kalimantan I (1990) 120. — Type: *S 30854* (Anderson) (K holo; A, E, L, SAN n.v. iso), Borneo, Sarawak, Baram Distr., Gunong Api, 1 Oct. 1971.

Tree, up to 18 m high reported with a girth of 80 cm. *Bark* surface smooth, greyish brown to green, inner bark brownish, sapwood pale yellow. *Branches* glabrous, only very young twigs puberulous, prominently lenticellate. *Stipules* caducous, but often present on younger twigs, narrow ovate-triangular to subulate, 5–8 mm long, c. 1 mm wide at base, with scattered rusty hairs to puberulous. *Leaves*: petiole subterete, glabrous to scattered hairy, (3–)4–7 mm long, 1–1.5 mm diam.; lamina elliptic, slightly ovate or obovate, rarely lanceolate, 40–100 by 15–35 mm, index 2.4–3.2, stiffly coriaceous, chartaceous when young, base broadly cuneate to subrotundate, apex acuminate, acumen up to 15 mm long, margin entire, conspicuously revolute. *Venation*: secondary veins in 7–9(–11) pairs, mostly not prominent on adult leaves, rarely slightly prominent if leaf is not fully developed, sometimes darker than lamina, slightly bent and obliquely running towards the margin, distally narrowed and inconspicuously joining the next secondaries, no distinct fimbrial vein, margin cartilaginous, tertiary veins irregularly percurrent, ultimate venation reticulate. *Indumentum*: glabrous, rarely adaxially along the main veins few scattered hairs; leaves olive green above, shining; light green, slightly glaucous beneath, often conspicuously cinnamon-brownish when dry. *Inflorescence*: multibracteate glomerules of up to 10 (sub)sessile flowers, axil sometimes leafless, but not at special leafless branches. *Bracts* triangular, tiny, up to 1 by 1.5 mm, margin minutely ciliate (lens!). Staminate flowers not seen, pistillate flowers \pm perigynous, 2.5–4 mm diam., whitish pink, pedicel at most 1 mm long, up to 1 mm diam., puberulous like basal part of receptacle. *Sepals* (narrow) ovate to triangular, 1.5–2.5 by 1–1.5 mm, brownish puberulous outside. *Petals* whitish, obovately spatulate, base \pm narrowed, apex erose, c. 1–1.3 by 0.8–1 mm. Outer *disc* in pistillate flowers 1.5–2



Map 7. Distribution of *Bridelia adusta* Airy Shaw (●) and *Bridelia whitmorei* Airy Shaw (■).

mm diam., inner one crateriform, c. 0.5 mm long, completely surrounding the ovary, margin erose. *Ovary* ovoid, apically terminating into style, up to 0.8 mm diam., c. 1 mm high, styles very short, c. 0.5 mm long, shortly bifid at apex, not exerted. *Fruit* subglobose to ovoid, acute or blunt at apex, 7–8 mm long, 5–8 mm in diam. *Seed* one per fruit, not seen.

Distribution — N Borneo (so far known from two localities only). Map 7.

Habitat & Ecology — In primary forests, among limestone boulders; reported from c. 800–1800 m altitude.

Notes — 1. This species was described as a rare endemic from Sarawak and is so far only known from two collections from the original tree and another one from Sabah.

2. This species clearly belongs to sect. *Cleistanthoideae* with its one-seeded drupes and absent fimbrial vein, and not to sect. *Scleroneurae* as was erroneously mentioned by Airy Shaw. Morphologically it is rather close to *B. glauca*. The distinguishing features are: stiffly coriaceous leaves, revolute margin, less secondary veins (7–9 pairs only), its more acute leaf base, subsessile flowers and fruits.

3. More material is needed to corroborate the distinction of this taxon which is undoubtedly not that much isolated as Airy Shaw thought, putting it into the wrong section. But admittedly the combination of coriaceous leaves and few secondary veins is unique in sect. *Cleistanthoideae* as well.

14. *Bridelia balansae* Tutcher

Bridelia balansae Tutcher, J. Linn. Soc. 37 (1905) 66; Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 37; Jabl. in Engl., Pflanzenr. Heft 65 (1915) 72; Merr., Lingnan Sci. J. 5 (1927) 108, n.v.; Croizat & Hara, J. Jap. Bot. 16 (1940) 314; Hurusawa, J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 6 (6) (1954) 322; Keng, Taiwania 6 (1955) 38; H.L. Li, Woody Fl. Taiwan (1963) 419, f. 158; Anon., Fl. Hainanica 2 (1965) 143; Liu, Ligneous Pl. Taiwan (1976) 403, f. 94 (8), n.v.; Hsieh, Fl. Taiwan 3 (1977) 452, pl. 683 (instructive fig.); ed. 2, 3 (1993) 430, pl. 223; Phamhoang Ho, Cayco Vietnam 2 (1992) 289. — Type: *Herb. Hongkong Bot. Gard. 974* (K holo), sine loc.

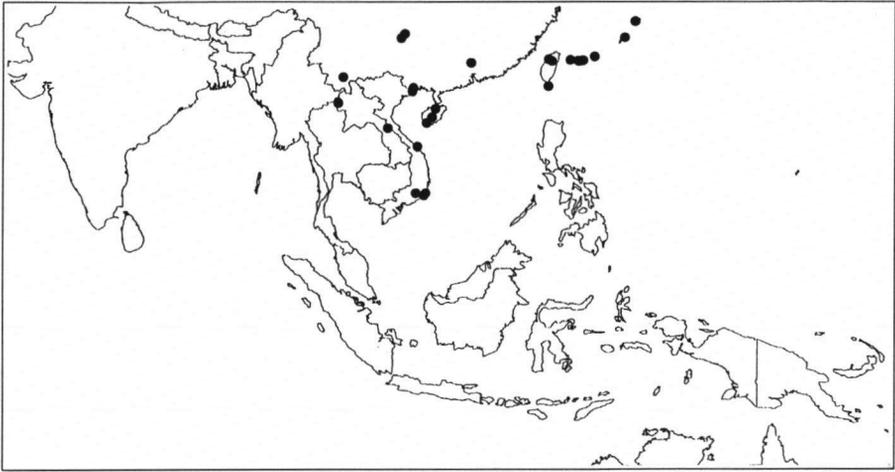
[*Bridelia pachinensis* Hayata ex Matsum. & Hayata, J. Coll. Sci. Tokyo 22 (1906) 362, nom. nud.] — Voucher: *Faurie 18* (BM), Formosa, in sylv. Maruyama, 1903.

Bridelia ovata auct. non Decne.: Hayata, Mat. Fl. Formosa (1911) 263; Gen. Ind. Fl. Formos. (1917) 65; Suzuki, Sylvania 4 (1933) 135; Kanehira, Form. Trees, rev. ed. (1936) 333, f. 288; Masam., Short Fl. Formos. (1936) 118 (sec. Croizat & Hara, 1940; Keng, 1955).

Bridelia pubescens auct. non Kurz: Jabl. in Engl., Pflanzenr. Heft 65 (1915) 73, quoad specim. Formosa (sec. Croizat & Hara, 1940; Keng, 1955).

Bridelia insulana auct. non Hance: P.T. Li, Fl. Reipubl. Pop. Sin. 44 (1) (1994) 37, tab. 9, f. 4–7 (instructive fig.).

Shrub to small tree, up to 10 m high, with erect, straight, slender stem (12–20 cm diam.), sometimes with short root-thorns. *Branches* slender, glabrous, inconspicuously lenticellate. *Stipules* early caducous, ovate-triangular, up to c. 1.8 mm long, 0.8–1 mm wide at base, sparsely brownish puberulous. *Leaves*: petiole subterete, glabrous, (3–)4.5–6(–8) mm long, 1–1.5 mm diam.; lamina elliptic, often rather lanceolate, 50–150 by 16–53 mm, index 2–3.4(–3.7), stiffly chartaceous to subcoriaceous, base acute, exceptionally obtuse, apex acute to shortly acuminate, acumen up to 15 mm long, margin entire, often revolute i.s. *Venation*: secondary veins in 8–12(–13) pairs, prominent beneath, continuously bent towards the margin, joining the next secondaries, tertiary veins weakly percurrent, \pm right-angled to secondaries, only slightly prominent, ultimate venation reticulate, inconspicuous. *Indumentum*: seemingly glabrous throughout, but some appressed scattered hairs on lower surface (lens!); leaves dull green, often glossy above, paler and glaucous beneath, brownish when dry. *Inflorescence*: small multibracteate glomerules of rather few (up to 10–12) shortly pedicelled flowers, forming cushion-like clusters, not terminal and not at special leafless branches. *Bracts* irregularly triangular, c. 1–1.5 by 0.5–0.8 mm, brownish puberulous with ciliate margin. *Flowers* (3.5–)4–5(–6; in fruit) mm diam., white to greenish yellow, pedicel 1.5–2 mm long, 0.5–2 mm diam., glabrous to sparsely puberulous, short and stout in pistillate flowers, slender in staminate (0.2–0.4 mm diam.). *Sepals* triangular, c. 1.5–2 by 1.2–2 mm, inside and outside puberulous, glabrous in fruit. *Petals* elliptic, trilobed or irregularly lobed, base cuneate or spatulate, c. 1 by 0.6–1 mm. *Disc* brownish, in staminate flowers 2–3 mm diam., outer one in pistillate flowers 2–3 mm diam., inner one c. 1 mm long, completely surrounding the ovary, margin erose. Free part of *filaments* c. 1 mm long. *Anthers* ovoid, c. 0.6–0.8 by 0.4–0.5 mm diam. Staminal column c. 1 mm long, pistillode conical ovoid, bifid at apex, up to 0.6 mm long, c. 0.3 mm diam. *Ovary* globoid, apically tapering into 2 styles, c. 1 mm diam., c. 1 mm high, two branches of styles c. 1.5 mm long, apical third bifid, exerted of flower. *Infructescence* with up to 5 (mostly 1–3) fruits. *Fruit* ovoidally ellipsoid, pointed at apex, 8–12(–17) mm long,

Map 8. Distribution of *Bridelia balansae* Tutcher.

5–7(–9) mm in diam., i.v. green ripening purplish red to black, i.s. bluish black; mesocarp rather thin, fleshy. *Putamen* woody, 8–11(–14) mm long, 5–7 mm diam. *Seed* 1 per fruit, ellipsoid to barrel-shaped, with deep lateral furrow, apex tapering, base bilobed, 6–8.5 mm long, 4–5 mm diam.; testa brownish.

Field notes— Flowers fragrant (*Lei 519*, B, K, L, Hainan; *Tsang 29404*, K, L, Tonkin)

Distribution — Laos, Vietnam, South China, Hainan, Ryukyus, Taiwan. — Map 8.

Habitat & Ecology — In thickets and forests (often secondary vegetation); reported from limestone and sandy soil; altitude from sea level up to 1500 m.

Uses — Fruits edible (*CCC 8101*, K, Hainan).

Notes — 1. The most outstanding features of *B. balansae* are the stiffly chartaceous to subcoriaceous, adaxially often glossy, lanceolate leaves with i.s. often revolute margins and the only few but rather large flowers which have a short and (in the pistillate state) stout pedicel.

2. *Bridelia insulana* is morphologically most similar but distinguished by numerous but much smaller (2–3 mm diam. at most) flowers and broader elliptic leaves which have nearly the same number of secondary veins as *B. balansae*. *Bridelia glauca*, however, also having one-seeded fruits, shows mostly pubescent, often truncate, larger leaves and numerous, in both sexes conspicuously stalked flowers.

3. One poor specimen from Thailand (*Koyama et al. T-48972*, L) shows a very unusual narrow-lanceolate leaf (index 3.2–4.7) and is reported to be a climber. Apart from that it could be matched with *B. balansae*.

15. *Bridelia cinnamomea* Hook. f. — Fig. 3

Bridelia cinnamomea Hook. f., Fl. Brit. India 5 (1887) 273; Boerl., Handl. Fl. Ned. Indië 3 (1900) 271; Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 38; Ridl., Fl. Malay Penins. 3 (1924) 185; Gage, J. Asiat. Soc. Bengal. 75 (1936) 490, 492; Whitmore, Tree Fl. Malaya 2 (1973) 74, in

- clavi; Tree Fl. Indon., Checkl. Kalimantan 1 (1990) 120. — *Bridelia griffithii* Hook. f. var. *cinnamomea* (Hook. f.) Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 38; Airy Shaw, Kew Bull., Add. Ser. 4 (1975) 64; Anderson, Checkl. Trees Sarawak (1980) 179; Airy Shaw, Kew Bull. 36 (1981) 273. — Type: *King's collector 7101* (K lecto, selected by Gage, 1936: 491; SING iso), Malaya, Kinta (erron. Kinla in Hooker f., 1887).
- Bridelia griffithii* Hook. f., Fl. Brit. India 5 (1887) 272, incl. var. *griffithii*; Brandis, Indian Trees (1906) 561; Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 38; Jabl. in Engl., Pflanzenr. Heft 65 (1915) 74. — Type: *Griffith 4883* (K lecto, here designated; U iso), Malacca.
- Bridelia ovata* auct. non Decne.: Kurz, For. Fl. Burma 2 (1877) 368 (sec. Hooker f., 1887).
- Bridelia gehrmannii* Jabl. in Engl., Pflanzenr. Heft 65 (1915) 73; Merr., Bibl. Enum. Born. Pl. (1921) 335; Masam., Enum. Phan. Born. (1942) 390. — Type: *Haviland & Hose 1858* (B? holo, destr.; L lecto, selected here; BM, E, K, L, SING iso), Borneo, Sarawak, Kuching, 24 Feb. 1893.
- Bridelia moonii* auct. non Thw.: Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 37 as to the Bornean reference (sec. Merrill, 1921).

Scrambling shrub, rarely small tree, up to 6 m high, with thorny brownish grey stem and creeping greyish branches with brown lenticels. Inner *bark* fibrous, yellow green. *Branches* brown, whitish lenticellate, reddish brown pubescent to tomentose when young, later glabrous. *Stipules* early caducous, widely ovate, 1.5–2 mm long, c. 2 mm wide, brownish pubescent. *Leaves*: petiole terete, whitish to brownish pubescent or tomentose, 4–8 mm long, c. 1 mm diam.; lamina elliptic, sometimes slightly obovate, 40–120 by 18–65 mm, index 1.5–2.4, chartaceous, base acute, rarely bluntly rounded, apex acute to rounded, very shortly acuminate, acumen 3–7 mm long, margin \pm entire. *Venation* visible above, prominent beneath, secondary veins in (5–)6–9(–10) pairs, especially at the base with a rather acute angle of divergence, distally arching towards the margin and joining the next secondaries, not the weak marginal vein, tertiary veins percurrent, scalariform, \pm right-angled to midvein. *Indumentum* reddish brown, abaxially puberulous to pubescent, rarely nearly glabrous, adaxially glabrous, only at veins pilose; leaves i.v. deep green above, bluish to greyish green with pale brownish venation beneath. *Inflorescence*: multibracteate glomerules of 10–20 subsessile to pedicelled, brownish red, yellow- to green-centred flowers, normally not terminal and not at special leafless branches. *Bracts* narrow-triangular, up to 4 by 1 mm, brownish tomentose to woolly. *Flowers* 4–5 mm diam., pedicel up to 3 mm long, 0.5 mm diam., brownish pubescent. *Sepals* triangular, 1.5–2 by 1.2–1.5 mm, puberulous, at least at base outside. *Petals* variable in shape, base spatulate, apex roundish to lobulate, greenish yellow with pink base (sec. coll.), c. 1 mm by 0.7–0.8 mm, in pistillate flower outside pubescent to tomentose and somewhat fleshy. *Disc* in staminate flowers c. 1.8 mm diam., outer one in pistillate flowers c. 1.8 mm diam., wrinkled, inner one 0.7 mm long when tubular, scales c. 1 mm long. Free part of *filaments* 1–1.2 mm long, 0.1 mm diam. *Anthers* shortly semi-globoid, c. 0.4–0.5 mm diam. Staminal column c. 1 mm long, pistillode conical-ovoid, blunt at apex, bifid, 0.7–0.8 mm long, 0.3–0.6 mm diam. *Ovary* globoid, apex conically pointed, c. 1.2 mm diam., c. 1.2 mm high, styles c. 1 mm long, deeply bifid (upper third), not exerting flower, stigma papillose. *Infructescence* with c. 3 or 4 subsessile fruits. *Fruit* ovoid to globoid, tapering or only pointed at apex (remnant of styles), 6–7 mm long, 5–5.5 mm in diam., i.v. glossy yellow green, tinged reddish, i.s. dark brown. *Putamen* woody, glossy. *Seed* one per fruit, (semi)ellipsoid with lateral furrow, 4–5 mm long, 2.3–3.5 mm diam.; testa light brown.

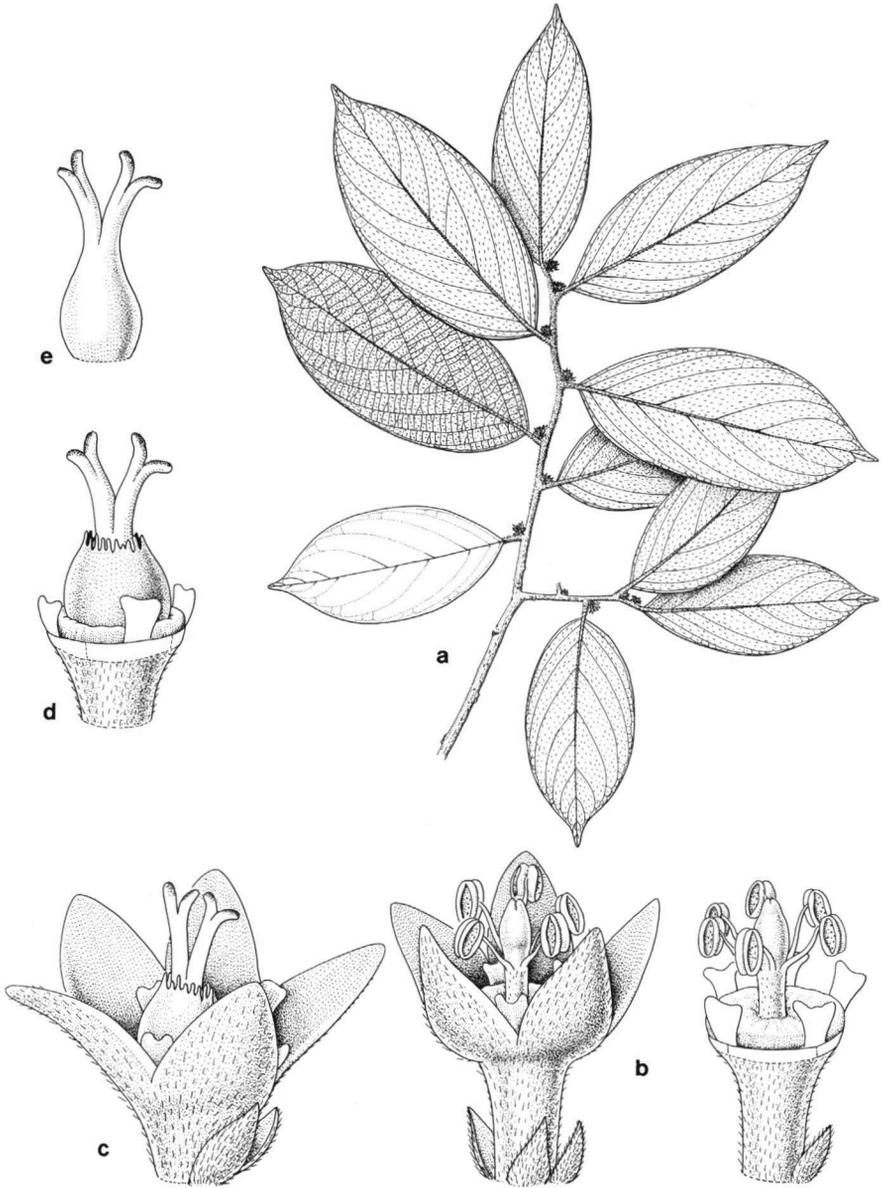


Fig. 3. *Bridelia cinnamomea* Hook. f. a. Habit, $\times 0.5$; b. two male flowers, one with sepals removed (note the short pedicel); c. female flower; d. female flower with sepals removed (note the outer and inner disc); e. isolated ovary; b–e all $\times 12.5$ [a, c–e: S 30702 (Anderson); b: SF 40257 (Sinclair)]. Drawing by J.H. van Os (L).

Field notes — Flowers are reported as smelling (*Lörzing 16440, L.*)

Distribution — Thailand, Malay Peninsula, Sumatra, Borneo (known so far from Sabah and Sarawak). — Map 9.

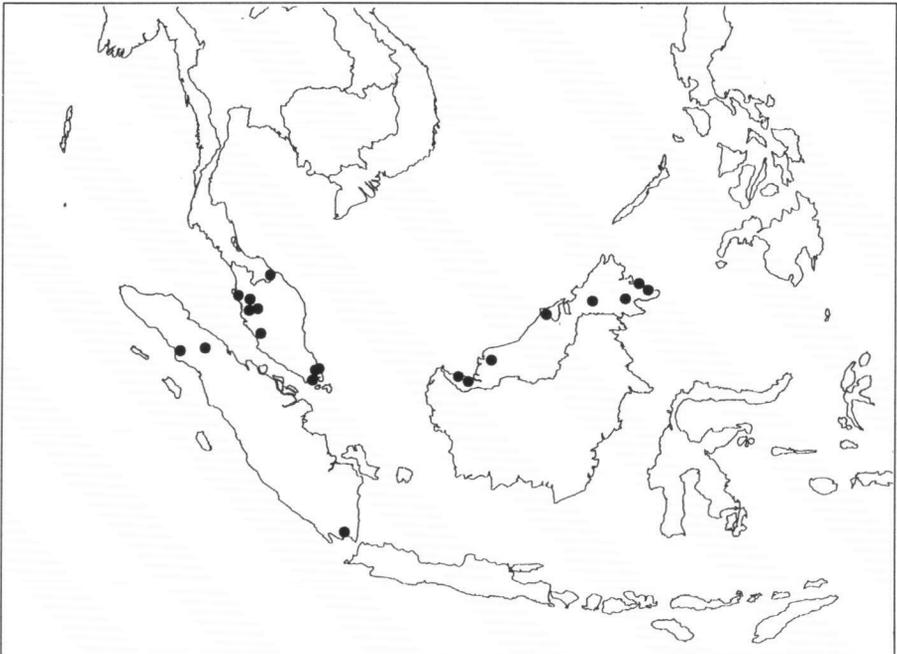
Habitat & Ecology — Primary and secondary mixed peat swamp forests; occasional; in lower altitudes from sea level up to 600 m.

Notes — 1. This species can easily be identified by its rather small leaves with acute base and reddish indumentum below, by the comparatively few (6–9) lateral nerves which have a conspicuously acute angle of divergence in the basal part of the leaf. Especially the staminate flowers are often shortly pedicelled and the styles are not exserting in the pistillate ones.

2. It belongs to a group of closely related species together with *B. insulana*, *B. glauca*, and *B. pustulata*. Morphologically, the latter seems closest related although it is distinguishable by several features (tree, leaf size and form, number of secondary veins, big protruding inflorescence cushions, pistillate inner disc sometimes hairy outside).

3. Apparently, *B. cinnamomea* is confined to swampy areas and ranges in lower altitudes.

4. The material distributed by Kew as *Griffith* (*Kew Distr. 4883*) is obviously heterogeneous: Specimens labelled *Griffith* (*Kew Distr. 4883*) = *Maingay 1371* represent the type collection of *B. pustulata* and the ones solely named *Griffith 4883* the type collection of *B. griffithii* (= *B. cinnamomea*).



Map 9. Distribution of *Bridelia cinnamomea* Hook. f.

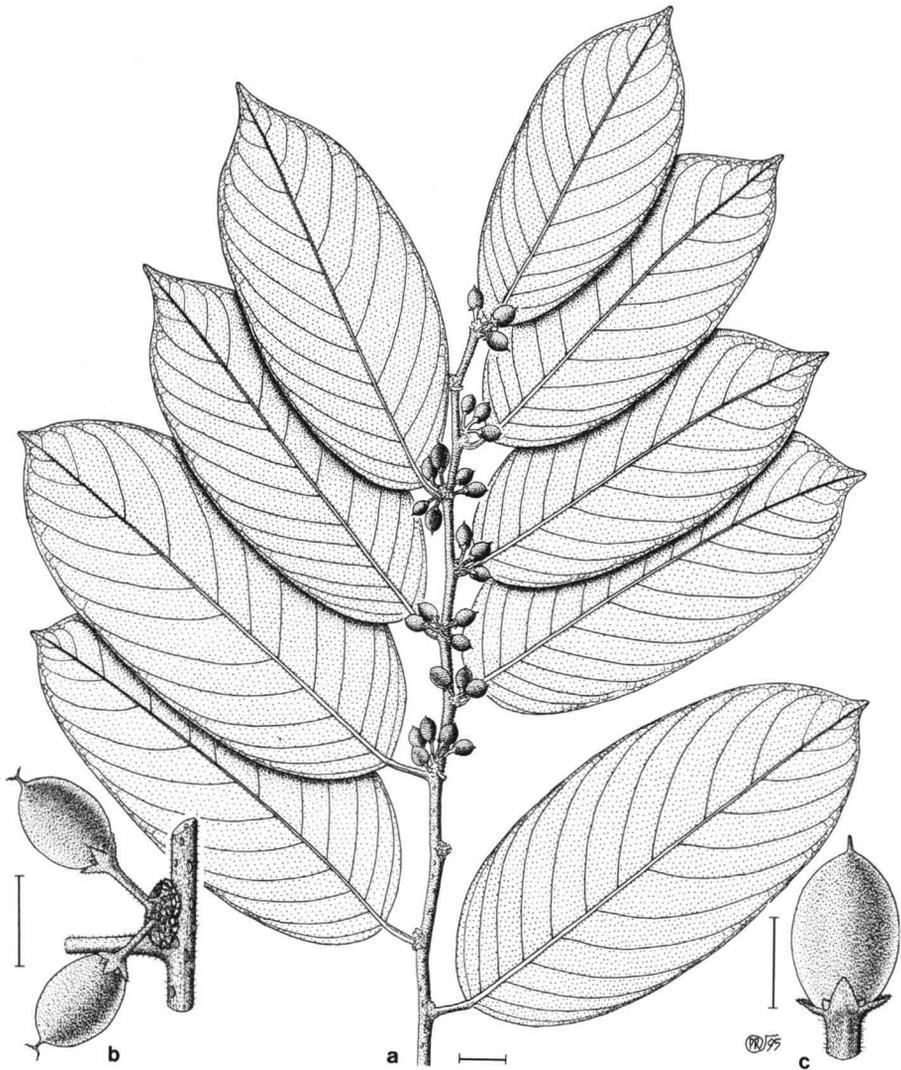


Fig. 4. *Bridelia glauca* Blume. a. Habit; b. infructescence; c. fruit (note the different shape of pedicels) (a–c: *Ambriansyah & Arifin AA 570*, WAN). Scale bar in a = 1 cm, in b & c = 5 mm. Drawing by Priyono (WAN).

16. *Bridelia glauca* Blume — Fig. 4

Bridelia glauca Blume, *Bijdr.* (1826) 597; *Span.*, *Linnaea* 15 (1841) 347; Hassk., *Cat. Hort. Bot. Bogor.* (1844) 240; Miq., *Fl. Ned. Indië* 1, 2 (1859) 364; D. Dietrich, *Syn. Pl.* 5 (1852) 383; Baill., *Étude Euphorb.* (1858) 584; Müll. Arg. in DC., *Prodr.* 15, 2 (1866) 497; Boerl., *Handl. Fl. Ned. Indië* 3 (1900) 271; J. J. Sm. in *Koord. & Valetton, Bijdr. Booms. Java* 12 (1910) 307; Hallier f., *Meded. Rijks-Herb.* 1 (1910) 7; *Koord., Exk.-Fl. Java* 2 (1912) 485, in clavi; Jabl. in *Engl., Pflanzenr. Heft* 65 (1915) 74; Merr., *Enum. Philipp. Flow. Pl.* 2 (1923) 423; Pap. Michi-

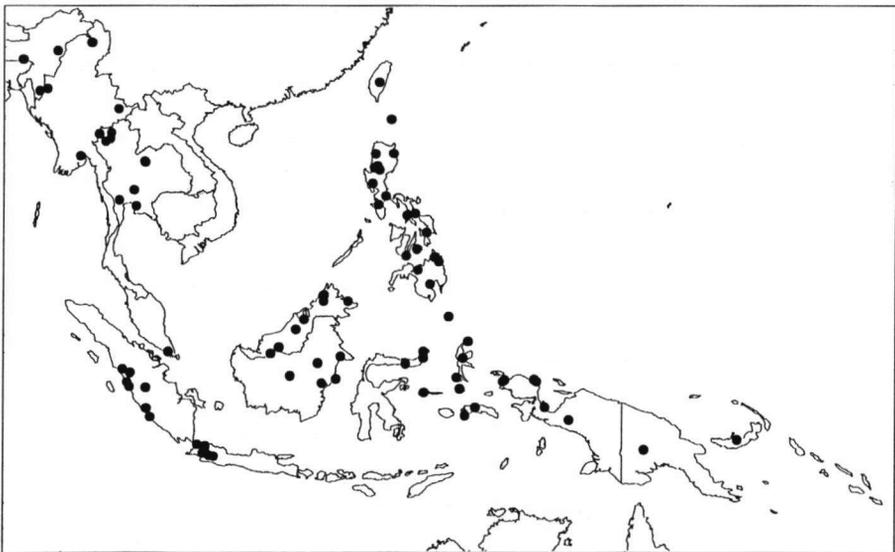
- gan Acad. Sci. 24 (1939) 76; Holthuis & H.J. Lam, *Blumea* 5 (1942) 200; K. Heyne, *Nutt. Pl. Ned. Indië*, ed. 3 (1950) 918; *Salvosa*, *Lex. Philipp. Trees* (1963) 89; Backer & Bakh. f., *Fl. Java* 1 (1964) 475, in clavi; Meijer, *Bot. News Bull. For. Dept.*, Sabah 7 (1967) 39, in clavi; Airy Shaw, *Kew Bull.*, Add. Ser. 4 (1975) 64; *Kew Bull.*, Add. Ser. 8 (1980) 43; Anderson, *Checkl. Trees Sarawak* (1980) 179; Airy Shaw, *Kew Bull.* 36 (1981) 273; *Kew Bull.* 37 (1982) 10; *Enum. Euphorb. Philipp. Isl.* (1983) 11; Whitmore, *Tree Fl. Indon.*, *Checkl. Kalimantan* 1 (1990) 120. — Type: *Blume s.n.* (L lecto, designated by Müll. Arg. in DC., 1866; L, NY iso), in insulae Javae in sylvis ad pedem montis Salak.
- Bridelia multiflora* Zipp. in *Miq.*, *Ann. Mus. Lugd.-Bat.* 4 (1869) 119 (Hallier f., 1910, syn. nov.); *Koord.*, *Versl. Minahasa* (1898) 582; Boerl., *Handl. Fl. Ned. Indië* 3 (1900) 271; Hallier f., *Meded. Rijks-Herb.* 1 (1910) 7. — Type: *Zippelius (235c?)* (L holo; BO iso), Amboina, Sept. 1828.
- Bridelia pubescens* Kurz, *J. Asiatic Soc. Beng.* 42, ii (1874) 241, syn. nov.; Kurz, *Prelim. Rep. For. Pegu* (1875) App. A: cix., App. B.: 78, in clavi; *For. Fl. Burma* 2 (1877) 367; Hook. f., *Fl. Brit. India* 5 (1887) 270; *Prain, Bengal Pl.* (1903) 928, repr. (1963) 694; Brandis, *Indian Trees* (1906) 560; Gehrm., *Bot. Jahrb. Syst.* 41, *Beibl.* 95 (1908) 37; *Jabl. in Engl.*, *Pflanzenr. Heft* 65 (1915) 73; Parija & Misra, *J. Indian Bot. Soc.* 12 (1933) 227; Merr., *Pap. Michigan Acad. Sci.* 24 (1939) 76; Hurusawa, *J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot.* 6 (6) (1954) 322; Airy Shaw, *Kew Bull.* 26 (1972) 230; Grierson & Long, *Fl. Bhutan* 1 (3) (1987) 770. — Type: *Kurz 2474* (K lecto, here designated; BM, K iso), Burma: Pegu, Yomah.
- Cleistanthus myrianthoides* C.B. Rob., *Philipp. J. Sci.*, Bot. 6 (1911) 325 (*Jabl.*, 1915: 54, syn. nov.). — Type: *FB 10679 (Curran)* (US # 709742 iso), Philippines, Luzon, Prov. Camarines, Caramoan, San Roque.
- Bridelia lauraefolia* Elmer, *Leafl. Philipp. Bot.* 7 (27 March 1915) 2637, syn. nov. — Type: *Wenzel 411* (BM lecto, here designated; GH # 45887 iso), Philippines, Mindanao, Leyte, Dagami, 8 Sept. 1913.
- Bridelia glauca* f. *laurifolia* *Jabl. in Engl.*, *Pflanzenr. Heft* 65 (22 June 1915) 75 (Airy Shaw, 1983: 11, syn. nov.); *Salvosa*, *Lex. Philipp. Trees* (1963) 89. — Type: *FB 18195 (Curran, Merrill & Zschokke)* (L lecto, here designated; K, NY iso), Philippines, Prov. Benguet, Mt Pulong.
- Bridelia nooteboomii* Chakrab., *J. Econ. Taxon. Bot.* 5 (1984) 949, syn. nov. — Type: *Nooteboom 761A* (PBL n.v. holo; L, PBL n.v. iso), Thailand, Northern Region, NW of Chiangmai, Doi Pui, 19° N, 98° 30' E, 1300 m, 11 Jan. 1969.

(Shrub to) tree, up to 30 m high, with a clear bole up to 18 m high, 40 cm dbh, sometimes with few buttresses (1.5 m high, 3 m out, 10 cm thick), basal trunk sometimes provided with root-thorns. Outer bark dark greyish brown, to 5 mm, smooth, rarely fissured, not peeling off, inner bark yellowish white, up to 4 mm, sapwood up to 5 cm, yellowish white to orange, no exudate, heartwood ochre to dark brown. Branches reddish brown pubescent to tomentose (especially when young), inconspicuously lenticellate, older branchlets thorny. *Stipules* plain green, ovate triangular, 8–12 mm long, base 3–5(–6) mm wide, brownish pubescent, caducous, but often present on younger twigs. *Leaves*: petiole subterete, pubescent, 5–11 mm long, 1–2.5 mm diam.; lamina elliptic, slightly ovate, rarely lanceolate, 40–280 by 20–120 mm, index 1.9–3.1, chartaceous, rarely membranaceous, base acute, obtuse, or (often) truncate, apex acute to acuminate, acumen up to 25 mm long, margin entire. *Venation*: secondary veins in (7–)11–18(–20) pairs, prominent beneath, continuously bent towards the margin, joining the next secondaries, tertiary veins weakly percurrent, ± right-angled to secondaries, only slightly prominent, ultimate venation reticulate. *Indumentum*: adaxially glabrous, rarely along the main veins scattered hairy, abaxially light brownish to reddish pubescent, rarely glabrous or tomentose beneath; leaves dark green above, sometimes glossy; light green, slightly glaucous beneath, brownish when dry. *Inflorescence*: multibracteate glomerules of many (up

to 50) conspicuously pedicelled, rarely only sessile flowers, not terminal and not at special leafless branches. *Bracts* tiny, triangular, < 1 mm long, densely brownish pubescent, very inconspicuous (lens!). *Flowers* 3–5 mm diam., yellowish green, pedicel (1–)2–6 mm long, 0.3–2 mm diam., densely pubescent, rarely glabrous, pedicel of pistillate flowers sometimes stouter. *Sepals* (narrow) triangular, 1.5–2.3 by 1–1.5 mm, brownish pubescent or puberulous outside. *Petals* whitish, lanceolate, spatulate, cuneiform or rectangular, base \pm narrowed, 0.6–0.8 by 0.2–0.5 mm. *Disc* brownish, in staminate flowers yellow whitish, 1.5–2 mm diam., outer one in pistillate flowers 1.2–1.5 mm diam., inner one crateriform, c. 0.5 mm long, completely surrounding the ovary, with a ring of few hairs inside, the pistillate flowers \pm perigynous. Free part of *filaments* up to 1 mm long, very slender, whitish. *Anthers* pale yellow, ellipsoid to slightly ovoid, 0.5–0.6 by 0.3–0.4 mm, staminal column 0.8–1.5 mm long, pistillode conical cylindrical, blunt at apex, up to 0.5 mm long, c. 0.2 mm diam. *Ovary* globose to slightly ovoid, apically terminating into the style, 0.3–0.4 mm diam., 0.6–0.7 mm high, styles up to 1.2 mm long, lower half united, apical branches of styles bifid, slightly exserting. *Infructescence* with up to 8 fruits. *Fruit* (conical) ellipsoid, acute or blunt at apex, 5.5–10(–12) mm long, 4.5–7.5(–9) mm in diam., i.v. pale purple, turning black with some light (white or pink) spots, i.s. bluish black; mesocarp juicy, sweetish. *Putamen* woody, ellipsoid, 5–8 mm long, 4–8 mm diam. *Seed* one per fruit, ellipsoid with shallow lateral furrow, 4.5–6.5 mm long, 3–4.5 mm diam.; testa rugulate, light greenish brown.

Field notes — Fruits said to be sweetish and edible (*Prawiroatmodjo* 422, Borneo).

Distribution — India, Bhutan, Sikkim, Burma, Thailand, Laos, Taiwan, Malay Peninsula, Sumatra, Java, Borneo, Philippines (not found on Palawan), Celebes, Moluccas (Talaud Is., Morotai, Halmahera, Obi, Bacan = Batjan, Taliaboe Is., Ambon, Ceram), New Guinea; Bismarck Archipelago (New Britain). — Map 10.



Map 10. Distribution of *Bridelia glauca* Blume.

Habitat & Ecology — In (sometimes disturbed) primary and secondary forests, often near rivers; reported from well-drained volcanic as well as from sandy, loamy, or clayey soil; over sandstone, limestone, grey schists, or granite; scattered to common; up to 1500 m altitude.

Uses — Timber tree, wood hard and durable, used for house and bridge construction (J.J. Smith, 1910; K. Heyne, 1950), good house posts and fuel in Mindanao, Philippines (*PNH 97554*, L; *Zwickey 708*, NY); used in the Agri ritual on Mindanao (*PHN 36045*, L).

Notes — 1. This species can be easily identified by its mostly conspicuously pedicelled flowers, its often truncate leaf base, by the (in sect. *Cleistanthoideae*) comparatively large number of lateral veins (11–18), and by the perigynous flowers where the inner disc has a ring of hairs inside and the styles are only slightly exerted. It resembles *B. insulana* a little but is nevertheless distinguishable by its larger and pedicelled flowers and the greater number of secondary veins. Because of the tiny bracts the deflowered glomerules resemble smooth cushions and do not have the rather rugged appearance of those of *B. insulana*. The endemic *B. moonii* from Sri Lanka shares the number of secondary vein pairs (12–18) with *B. glauca* but has sessile flowers and fruits and a mostly acute leaf base.

2. The collections from the Asian mainland were always referred to as *B. pubescens*. However, I could not trace any feature distinguishing it from *B. glauca*. Some collections (including the type of *B. pubescens*) have rather short pedicels only (often due to an early stage of inflorescence development) but others are distinctly pedicelled and no hiatus could be traced. Both taxa are therefore considered to be conspecific.

3. The occurrence of the rather uncommon phenomenon of root-thorns was described for *B. pubescens* (Parija & Misra, 1933) and probably the trunk spines reported in some other *Bridelia* spp. are of the same origin.

4. A careful study of the isotype of *B. nooteboomii* in L revealed that the species does not belong to sect. *Scleroneuræ* at all as stated by Chakrabarty. The fruits are obviously unilocular and the secondary veins do anastomose before the margin. Both features are also described in the protologue and indicate clearly that the species belongs to sect. *Cleistanthoideae*. I cannot find any character which distinguishes the taxon from *B. pubescens* (= *B. glauca*). A relation to *B. tomentosa* as stated by the original author is absolutely not evident.

Three varieties may be distinguished under *Bridelia glauca*:

- Leaves glabrous beneath **b. var. acuminatissima**
- Leaves pubescent beneath **a. var. glauca**
- Leaves rufous-tomentose beneath **c. var. sosopodonica**

a. var. glauca — See the species

b. var. acuminatissima (Merr.) S. Dressler, *stat. nov.*

Bridelia acuminatissima Merr., Philipp. J. Sci., Bot. 9 (1914) 473; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 422; Airy Shaw, Enum. Euphorb. Philipp. Isl. (1983) 11. — Type: *Phil. Pl. 1551* (*Ramos*) (A, BM, L, NY, SING iso), Philippines, Luzon, Prov. Camarines, Mt Isarog, along streams in forests, 25 Nov. 1913.

Bridelia acuminatissima described from the Philippines is based mainly on its rather glabrous and slenderly acuminate leaves. These characters are not confined to this area only and occur in various combinations elsewhere. The leaf shape is often variable and the leaf apex of pubescent forms of *B. glauca* is sometimes rather acuminate too but the lack of an indumentum is considered worth taxonomic ranking. Therefore I reduce this taxon to a variety under *B. glauca* especially as it shares important other features (e. g. pedicelled flowers) with the latter.

c. var. *sosopodonica* (Airy Shaw) S. Dressler, *stat. nov.*

Bridelia sosopodonica Airy Shaw, Kew Bull. 23 (1969) 67; Kew Bull., Add. Ser. 4 (1975) 65; Whitmore, Tree Fl. Indon., Checkl. Kalimantan 1 (1990) 121. — Type: SAN 38274 (*Sinanggul*) (K holo; L iso), Sabah (N Borneo), Ranau Distr., Bukit Sosopodon, Kundasang, near Mile 38, 1050 m, 25 June 1963.

Specimens with a stronger rufous tomentose indumentum originally described as a very local Bornean endemic (*B. sosopodonica* Airy Shaw) appear to occur also elsewhere (e. g., India, Laos, Java, Philippines, Moluccas) and the other distinguishing features mentioned by Airy Shaw fall within the variability of *B. glauca* (stipule and fruit size). Therefore this taxon is reduced to varietal rank with the strongly developed indumentum as distinguishing character although I have to admit that specimens intergrading to *B. glauca* var. *glauca* occur.

17. *Bridelia insulana* Hance

Bridelia insulana Hance, J. Bot. 15 (1877) 337; Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 33; Jabl. in Engl., Pflanzenr. Heft 65 (1915) 63; P.T. Li, Acta Phytotax. Sin. 26 (1988) 63; Reipubl. Pop. Sin. 44(1) (1994) 37, p. p. — Type: *Pierre 19762* (BM holo; K, P? iso), Cochinchina (= S Vietnam), in ins. Phukok, Febr. 1874.

Bridelia penangiana Hook. f., Fl. Brit. India 5 (1887) 272 (P.T. Li, 1988, syn. nov.); Boerl., Handl. Fl. Ned. Indië 3 (1900) 271; Jabl. in Engl., Pflanzenr. Heft 65 (1915) 75; Ridl., Fl. Malay Penins. 3 (1924) 185; Burkill, Dict. Econ. Pl. Malay Penins. (1935) 365; Gage, J. Asiat. Soc. Bengal. 75 (1936) 492; Airy Shaw, Kew Bull. 26 (1972) 229; Whitmore, Tree Fl. Malaya 2 (1973) 75, in clavi; Airy Shaw, Kew Bull., Add. Ser. 4 (1975) 64; Kew Bull. 31 (1976) 382; Kew Bull., Add. Ser. 8 (1980) 44; Kew Bull. 35 (1980) 602; Muellera 4 (1980) 223; Anderson, Checkl. Trees Sarawak (1980) 179; Airy Shaw, Kew Bull. 36 (1981) 273; Kew Bull. 37 (1982) 11; Enum. Euphorb. Philipp. Isl. (1983) 11; Whitmore, Tree Fl. Indon., Checkl. Kalimantan 1 (1990) 120; Hnatiuk, Austral. Fl. Fauna Ser. 11 (1990) 180; Chapman, Austral. Fl. Fauna Ser. 12 (1991) 477. — *Bridelia griffithii* var. *penangiana* (Hook. f.) Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 38. — Type: *Curtis 527* (K holo; SING iso), Malaya, Penang, on Government Hill, 1885.

Bridelia minutiflora Hook. f., Fl. Brit. India 5 (1887) 273 (Gage, 1936: 493, syn. nov.); Koord., Versl. Minahasa (1898) 581; Boerl., Handl. Fl. Ned. Indië 3 (1900) 271; Brandis, Indian Trees (1906) 561; J.J. Sm., Nova Guinea 8 (1910) 231; in Koord. & Valetton, Bijdr. Booms. Java 12 (1910) 310; Koord., Exk.-Fl. Java 2 (1912) 485, in clavi; Jabl. in Engl., Pflanzenr. Heft 65 (1915) 76; Merr., Bibl. Enum. Born. Pl. (1921) 335; Enum. Philipp. Flow. Pl. 2 (1923) 423; Gagnep. in Lecomte, Fl. Indo-Chine 5 (1926) 493; Merr., Univ. Calif. Publ. Bot. 15 (1929) 155; C.T. White, Proc. Roy. Soc. Queensl. 47 (1936) 80; Holthuis & H.J. Lam, Blumea 5 (1942) 200; Masam., Enum. Phan. Born. (1942) 390; K. Heyne, Nutt. Pl. Ned. Indië, ed. 3 (1950) 918; Salvosa, Lex. Philipp. Trees (1963) 89; Backer & Bakh. f., Fl. Java 1 (1964) 475, in clavi; Meijer, Bot. News Bull. For. Dept., Sabah 7 (1967) 39, in clavi; Hyland, Card Key

Rain for. Trees North Queensl. (1971) 71; Peekel, Fl. Bismarck Archip. (1984) 297, f. 481; Chapman, Austral. Fl. Fauna Ser. 12 (1991) 477; Pham-hoang Ho, Cayco Vietnam 2 (1992) 289. — Type: *Griffith 867* [K lecto, designated by Airy Shaw, Kew Bull. 35 (1980); K iso], Burma, Tenasserim, Mergui.

Bridelia ovata auct. non Decne.: Merr., Philipp. Bur. For. Bull. 1 (1903) 30 (sec. Merrill, 1923).

Bridelia minutiflora var. *abbreviata* J.J. Sm. in Koord. & Valetton, Bijdr. Booms. Java 12 (1910) 313, syn. nov. — Type: *Koorders 25549* (L lecto, here designated; BO iso), Java, Prov. Preanger, 1896.

Bridelia platyphylla Merr., Philipp. J. Sci., Bot. 7 (1912) 384 (Merrill, 1923: 423, syn. nov.). — Type: *FB 11167 (Aguilar)* (type fragm: US # 706710), Philippines, Luzon, Prov. Bulacan, Angat, April 1908.

Bridelia morotaea Airy Shaw, Kew Bull. 37 (1982) 10, syn. nov. — Type: *bb 33815 (Exp. Koster-mans), Tangkilisan No. 123* (K holo; A, BO, BR, CALC n.v., L, LAE n.v., M n.v., P n.v., S n.v. iso), Moluccas, Morotai, Subdistr. Tobelo, N Totodokoe, 30 m, 11 May 1949.

Bridelia nicobarica Chakrab. & Vasudeva Rao, J. Econ. Taxon. Bot. 5 (1984) 945, syn. nov. — Type: *N. G. Nair 3523A* [PBL n.v. holo; L, PBL n.v. (nr. 3523B) iso], Nicobar Islands, Sawai, 24 Febr. 1976.

?*Bridelia palauensis* Kaneh. in Kaneh. & Hatus., Bot. Mag. Tokyo 53 (1939) 152, prov. syn. nov., type n.v.; Kaneh., J. Dept. Agric. Kyushu Imp. Univ. 4 (1935) 347. — Type: *S. Hatusima 4803*, Palau, Peliliu, 7 April 1938 (not traced).

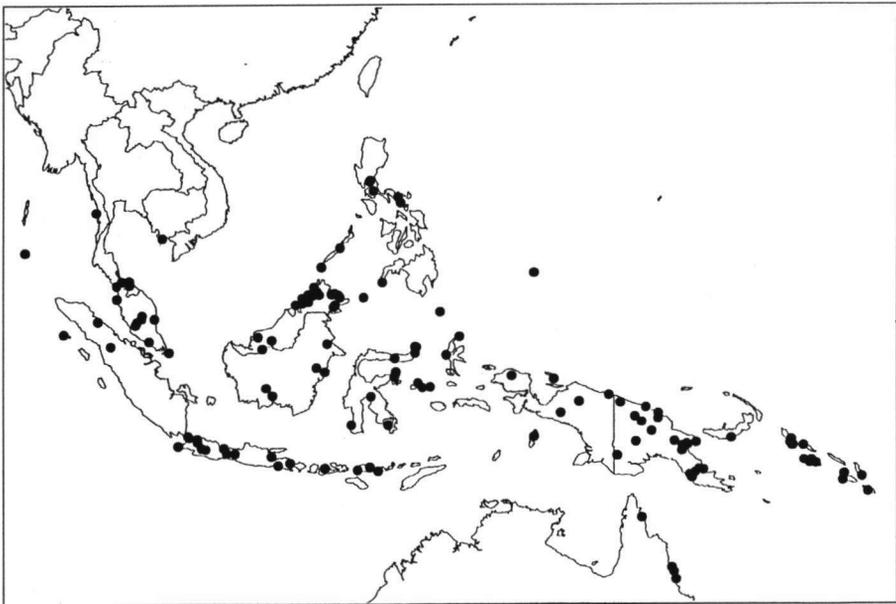
?*Bridelia griffithii* var. *glabra* Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 38, prov. syn. nov. — No type designated.

Medium to large tree, 10–25 m high, 25–60 cm diam., with big, diffusely spreading crown and clear bole or multistemmed, sometimes buttressed. Outer *bark* grey brown, cracking, scaly, inner bark reddish to brownish, fibrous with granular wedges, sapwood yellowish to pale orange, slashwood whitish. *Branches* slender, glabrous, inconspicuously lenticellate, sometimes with a tendency to climbing, older branchlets thorny. *Stipules* early caducous, very narrow-triangular, up to 5 mm long, 0.8–1.3 mm wide at base, sparsely brownish puberulous. *Leaves*: petiole subterete, glabrous, 4–7(–8) mm long, 1–1.8 mm diam.; lamina (broadly) elliptic, very rarely slightly obovate, 45–210 by 25–88 mm, index 1.5–2.7, chartaceous, rarely subcoriaceous, base obtuse, rounded to acute, apex obtuse to acute but shortly acuminate, acumen up to 15 mm long, margin entire. *Venation*: secondary veins in 9–13(–14) pairs, prominent beneath, continuously bent towards the margin, joining the next secondaries, tertiary veins weakly percurrent, \pm right-angled to secondaries, only slightly prominent, ultimate venation reticulate. *Indumentum*: glabrous, rarely slightly puberulous beneath, if so, especially at veins; leaves dark green, sometimes glossy, slightly glaucous above, brownish when dry. *Inflorescence*: multibracteate glomerules of many (15–30) sessile to shortly pedicelled flowers, forming cushion-like clusters, not terminal and not at special leafless branches. *Bracts* triangular, c. 1.2 by 1.2 mm, brownish puberulous with ciliate margin. *Staminate flowers* 2–2.5 mm diam., creamy yellow, pistillate ones 2–3(–3.5) mm diam., whitish cream with red disc, pedicel at most 1.5 mm long, sparsely puberulous. *Sepals* triangular, c. 1.2 mm by 1 mm, brownish puberulous outside. *Petals* elliptic, trilobed or irregularly lobed, base cuneate, tiny, 0.3–0.5 by 0.3–0.5 mm. *Disc* brownish, in staminate flowers 1–1.2 mm diam., outer one in pistillate flowers c. 1.5 mm diam., inner one 0.5–0.7 mm long, completely surrounding the ovary. Free part of *filaments* up to 0.8 mm long. *Anthers* ovoid to semiglobose, c. 0.4 mm diam., dark red (sec. coll.). Staminal column c. 1 mm long, pistillode conical ovoid, blunt at apex, up to 0.5 mm long, c. 0.2 mm diam.

Ovary ovoid, apically terminating into style, c. 0.7 mm diam., c. 1 mm high, two branches of styles 1–1.5 mm long, shortly bilobed at apex, exserting. *Infructescence* with up to 10 fruits. *Fruit* ellipsoid to ovoid, pointed at apex, 6–11 mm long, 4–6 mm in diam., i.v. green ripening red, then purple-black, i.s. bluish black; mesocarp rather thin. *Putamen* woody. *Seed* one per fruit, ovoid, tapering at apex, 6–7 mm long, 3.5–4.5 mm diam.; testa greenish brown.

Field notes — Flowers faintly scented (*Hyland 7801*, L; *BSIP 12981*, L); leaves when crushed have a distinct strong almond odour (*Kajewski 2116*, L); blaze odour cucumber-like (*Hyland 3437*, L); day-old foliage with foul smell like *Hedyotis* (*Takeuchi et al. 4389*, L); fruits reported to be quite hard (*Hartley 11022*, K, L, New Guinea).

Distribution — Burma, Thailand, Indochina, Nicobar Islands, Malay Peninsula, Sumatra, Borneo, Philippines, Palau Islands, Java, Lesser Sunda Islands (Bali, Flores, Sumbawa), Moluccas (Morotai), New Guinea, Bougainville, Solomon Islands, Sta. Cruz Group; New Hebrides (Espirito Santo), Reef Is., Malalaika, Guadalcanal/S. Cristobal, Choiseul, New Georgia Group, Australia (Queensland). — Map 11.



Map 11. Distribution of *Bridelia insulana* Hance.

This species is reported to occur in China (P.T. Li, 1988, 1994), but no relevant specimens could be traced by me. It is suspected that these records refer to *B. balansae*.

Habitat & Ecology — Primary and secondary rain forests, often along rivers, but also on dry land, sandy to loamy or clayey soil, or on limestone; altitude from sea level up to 1500 m.

Uses — Timber sometimes used in house-building, Minahasa, Celebes (Koorders, 1898; J.J. Smith, 1910; Airy Shaw, *Kew Bull.*, Add. Ser., 1980), as house posts

(*Kajewski 2116*, L, Bougainville), for knife handles; as glossy black (*Kostermans 18190*, L, Sumbawa); bast used for colouring the saguwer (palm wine) red (Holthuis & Lam, 1942); fruits reported to be edible in Borneo and Indochina (*Tukirin 501*, L; Gagnepain, 1926); native medicine for headache in Sabah (*BNB For. Dept. 2817*, L; Airy Shaw, 1975), decoction of leaves is applied as a lotion against itch (Burkill, 1935); cover for smokes, New Guinea (*NGF 14854*, L).

Notes — 1. Characteristics of this species are the (broadly) elliptic leaves with often acute to obtuse base and 9–13 pairs of secondary veins only. The leaves are mostly glabrous beneath except for a few collections from E Malesia. The most outstanding feature, however, is formed by the very small flowers (up to 3 mm diam. only), whereas the calyces of *B. glauca* and *B. balansae* show diameters from 4–6 mm (up to 7 mm in fruit). The inflorescences have numerous flowers and when these are fallen off the inflorescence-cushions are of a rather rugged appearance due to the large bracts. *Bridelia balansae* is distinguishable by its fewer but larger flowers with the females always shortly and stoutly pedicelled and the mostly stiffer, rather lanceolate leaves. This species shares the rather low number of secondary vein pairs (8–13) with *B. insulana* as opposed to *B. glauca*. The latter differs by having conspicuously stalked flowers, an often truncate leaf base, and usually pubescent undersurfaces of the leaves.

2. Examining the holotype it proved that there can be no doubts about the conspecificity of *B. insulana*, a long neglected but older name, with *B. penangiana*, a commonly accepted name of this widespread species which unfortunately leads to a name change. P.T. Li (1988) already recognised the necessity of this nomenclatural alteration.

3. *Bridelia minutiflora* var. *abbreviata* is conspecific with *B. minutiflora* (= *B. insulana*) as the supposedly distinguishing characters (very short style and staminal column, less regular venation, bracts weaker hairy) fall within the normal variability and are even not consistent in the type material.

4. Merrill based his *B. platyphylla* on its larger leaves with 12–16 pairs of secondary veins, although he confirmed the occurrence of leaves half as long with only 8–10 vein pairs. The type in US shows one leaf with 12 and several with 8–9 pairs. Thus this taxon was already synonymised with *B. minutiflora* Hook. f. by Merrill himself in 1923. Airy Shaw (1972, 1975) therefore cited it as a synonym under *B. penangiana*. In his Philippines checklist (1983), however, he referred to it as *B. glauca* Blume. He probably came to this conclusion after examining one paratype of *B. platyphylla* (*BS 14557*, K). The isotype from US, however, clearly belongs to *B. insulana*.

5. *Bridelia morotaeta* is conspecific as the supposedly distinguishing characters (smaller, adaxially shining, subcoriaceous leaves with acuminate apex) fall within the normal variability of *B. insulana*.

6. A careful study of the isotype of *B. nicobarica* in L revealed that the species does not belong to sect. *Scleroneuræ* at all. The fruits are clearly unilocular. The secondary veins do anastomose before the margin. This indicates the species as belonging to sect. *Cleistanthoideae*, and the isotype I had at hand represents *B. insulana*, although I must admit that the leaves are rather coriaceous and glossy above. However, this is fairly common in this widespread species. This specimen is interesting

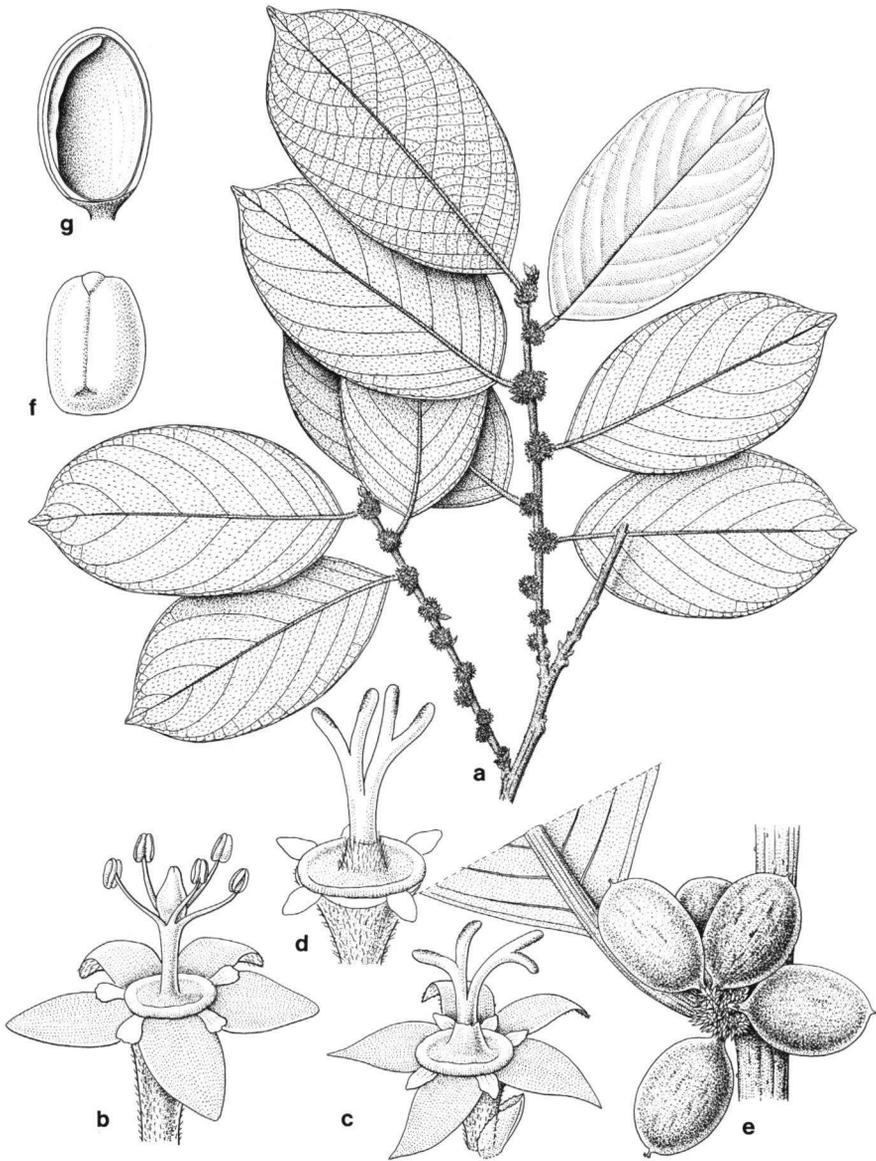


Fig. 5. *Bridelia pustulata* Hook. f. a. Habit, $\times 0.5$; b. male flower; c. female flower; d. female flower with sepals removed (note the hairs on the outside of the tubular disc), all $\times 12.5$; e. infructescence, $\times 2$; f. fruit interior; g. seed in ventral view, both $\times 3$ [a, c: FRI 2097 (Kochummen); b: Rahmat si Boeea 833; d: SAN 88817 (Madani); e-g: Reksodihardjo 710]. Drawing by J.H. van Os (L).

in another feature as well: the calyx of the fruit is intermediate in size (c. 3–4 mm diam.) between *B. balansae* and *B. insulana* but the large number of flowers per inflorescence clearly points towards the latter.

7. I have seen no type material of *B. palauensis* but several collections from the Palau Islands determined as *B. palauensis* represent *B. insulana* so that I suspect them to be conspecific. The original author wrote: "may be comparable with *B. griffithii* from SW Malay Prov., but easily distinguishable by its glabrous leaves which are basally acute, and their fewer lateral nerves" which perfectly matches *B. insulana*. As the reduction of *B. penangiana* to varietal rank under *B. griffithii* and the description of a var. *glabra* by Gehrman caused confusion, it is likely that Kanehira tried to solve this by describing a new species from the Palau Islands.

This species seems to have a broad ecological amplitude which is also reflected in its wide range and finds its expression in the morphological variability. Most of the Australian specimens are of a more xerophytic appearance (e.g., more prominent higher venation).

Two varieties are recognised under this species:

- Leaves glabrous beneath a. var. *insulana*
- Leaves pubescent beneath b. var. *subnuda*

a. var. *insulana* — See the species

b. var. *subnuda* (K. Schum. & Lauterb.) S. Dressler, *comb. nov.*

Bridelia subnuda K. Schum. & Lauterb., Fl. Schutzgeb. Südsee (1900) 393. — *Bridelia penangiana* var. *subnuda* (K. Schum. & Lauterb.) Airy Shaw, Kew Bull., Add. Ser. 8 (1980) 45. — Type: *Tappenbeck 64* (B? (destr.) holo; WRS� lecto, here designated), New Guinea, Kaiser-Wilhelmsland, Ramufluss, 1 June 1898.

This taxon differs from *B. insulana* var. *insulana*, which is typically glabrous, only by having an indumentum on the abaxial side of the leaves and \pm hairy petioles and young branchlets. It seems to be restricted to New Guinea and neighbouring islands, but intermediate forms could be found in the Philippines too. The indumentum of the lower leaf surface is rather variable so that no sharp limits can be drawn between both varieties.

18. *Bridelia pustulata* Hook. f. — Fig. 5

Bridelia pustulata Hook. f., Fl. Brit. India 5 (1887) 271; Boerl., Handl. Fl. Ned. Indië 3 (1900) 271; Gehrm., Bot. Jahrb. Syst. 41, Beibl. 95 (1908) 38; Jabl. in Engl., Pflanzenr. Heft 65 (1915) 74; Ridl., Fl. Malay Penins. 3 (1924) 185; Burkill, Dict. Econ. Pl. Malay Penins. (1935) 366; Gage, J. Asiat. Soc. Bengal. 75 (1936) 489, 492; Airy Shaw, Kew Bull. 23 (1969) 67; Whitmore, Tree Fl. Malaya 2 (1973) 74, in clavi; Airy Shaw, Kew Bull., Add. Ser. 4 (1975) 64; Kew Bull. 36 (1981) 274; Whitmore, Tree Fl. Indon., Checkl. Kalimantan 1 (1990) 120. — Type: *Maingay 1371* (K lecto, here designated; BM, GH, K, L iso), Malacca.

Tree (up to 20 m high) with clear bole, stiltroots, and dense crown; sharp thorns (2.5–3 cm long) reported from the trunk base. Outer bark dark brown, smooth,

scaly, or fissured, acrid smell, inner bark reddish to pale brown, fibrous, sapwood white brown, merging into darker brown hard heavy heartwood. *Branches* conspicuously light brownish lenticellate, rusty brown pubescent when young. *Stipules* early caducous, linear to very narrow-triangular, up to 8 mm long, c. 1.5 mm wide at base, sparsely brownish pubescent. *Leaves*: petiole terete, brownish pubescent, rarely nearly glabrous, 7–11 mm long, 1.2–2.8 mm diam.; lamina elliptic to oblong, sometimes slightly obovate or ovate, 90–230 by 30–115 mm, index 1.6–3, (sub)coriaceous, chartaceous when young, base acute, rounded, or obtuse, apex obtuse, rarely acute but shortly acuminate, acumen to 12 mm long, margin entire. *Venation* darker above, prominent beneath, secondary veins in 11 or 12 pairs, continuously bent towards the margin, joining the next secondaries, tertiary veins percurrent, scalariform, \pm patent to secondaries. *Indumentum* below brownish pilose to pubescent, above glabrous, only at veins pilose; leaves conspicuously blackish brown when dry. *Inflorescence*: multibracteate glomerules of many (> 20) sessile, brownish red to pink flowers, forming big cushion-like clusters with the pistillate flowers surrounded by staminate ones, normally not terminal and not at special leafless branches. *Bracts* ovate-triangular, 1.5–1.8 by up to 2 mm, brownish pubescent to tomentose. *Flowers* 3–4 mm diam., pedicel at most 0.3 mm long. *Sepals* narrow-triangular, 1.5–1.7 by 0.8–1 mm, brownish puberulous, especially at base and apex. *Petals* elliptic, apex sometimes irregularly lobed, white with darker centre (vein), tiny, 0.5–0.8 by 0.3–0.6 mm. *Disc* in staminate flowers c. 1.2 mm diam., outer one in pistillate flowers c. 1.5–1.7 mm diam., inner one 0.5 mm long and sometimes hairy outside. Free part of *filaments* up to 0.8 mm long. *Anthers* ovoid to semiglobose, c. 0.4 mm diam., dark red (sec. coll.). Staminal column c. 1.2 mm long, pistillode conical-ovoid, blunt at apex, up to 0.5 mm long, c. 0.3 mm diam. *Ovary* globose, c. 0.5 mm diam., c. 0.6 mm high, styles c. 2.3 mm long, united in lower quarter, shortly bilobed at apex, exerting, stigma lobate. *Infructescence* with up to 10 fruits, sometimes up to 1.5 mm stalked. *Fruit* ellipsoid to obovoid, blunt at apex, sometimes remnants of styles present, 7–8 mm long, 5–7 mm in diam., i.v. green ripening red then purple-black, i.s. bluish black; mesocarp rather copious. *Putamen* woody, 6–7 mm long, 4.5–5 mm diam. *Seed* one per fruit, ellipsoid with deep lateral furrow, 4 by 5 mm; testa light brown, granulate to rugose.

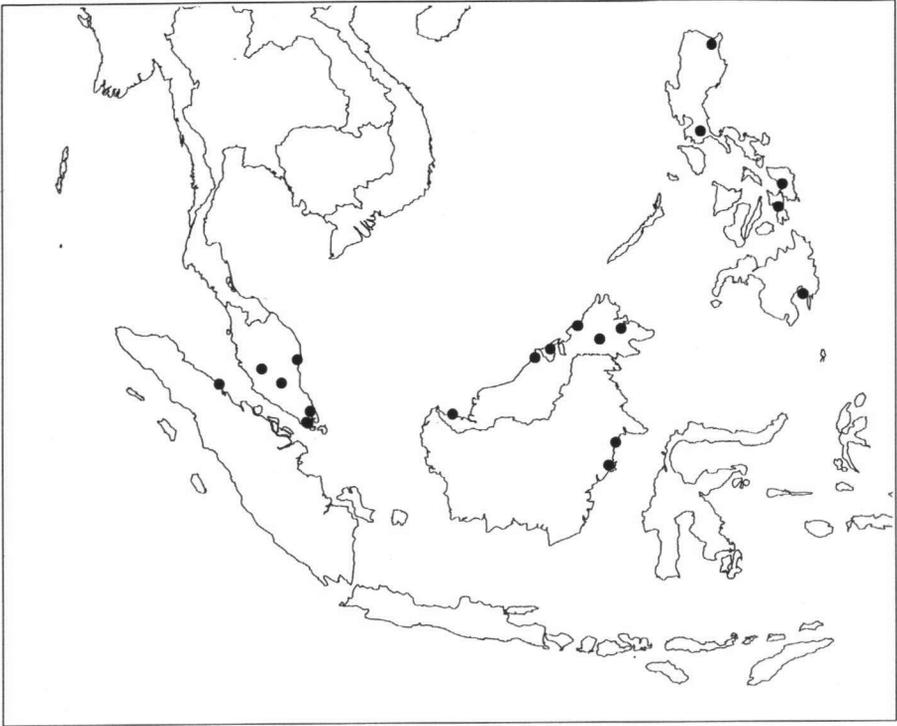
Distribution — Malay Peninsula, Sumatra, Borneo, Philippines. — Map 12.

Habitat & Ecology — Primary forests; from sea level up to 350 m altitude.

Uses — Timber tree, used for posts in native houses because of its durability (Burkill, 1935; Jansen et al. (eds.), PROSEA, Basic List of Species, 1991, Wagenin-gen).

Notes — 1. This species is characterised by the following features: big, protruding cushion-like inflorescence clusters with many sessile small flowers (more than 20); conspicuously blackish brown leaves in dry state with dark, prominent, scalariform tertiary venation; pistillate flowers with the inner tubular disc sometimes hairy outside and the styles strikingly exerted. The whole plant blackens conspicuously on drying.

2. The Kew and Leiden type specimens of *B. pustulata* (Maingay 1371) bear the annotation "Griffith (Kew Distrib. 4883)." The specimens labelled solely "Griffith



Map 12. Distribution of *Bridelia pustulata* Hook. f.

(Kew Distrib. 4883)" in K and U, however, are lectotype sheets of *B. griffithii* and represent *B. cinnamomea*. The material distributed as *Griffith 4883* is obviously heterogeneous!

3. This species seems not to occur frequently. It is closely related to *B. cinnamomea* and *B. insulana* (= *B. penangiiana*).

19. *Bridelia whitmorei* Airy Shaw

Bridelia whitmorei Airy Shaw, Kew Bull. 27 (1972) 77; Whitmore, Tree Fl. Malaya 2 (1973) 74, in clavi. — Type: *Whitmore FRI 8586* (K holo; KEP n.v., L iso), Malaya, Pahang, S Tembeling, near K. Keniyum, S Redab, rocky streambed, 240 m, 6 March 1968.

Big woody climber. *Branches* conspicuously light brownish lenticellate, glabrous. *Stipules* not seen, early caducous. *Leaves*: petiole terete, glabrous, rarely slightly puberulous, 4–6 mm long, c. 1 mm diam.; lamina elliptic to oblong, sometimes slightly obovate or ovate, 65–140 by 30–65 mm, index 1.7–2.4 (sub)coriaceous, base rotundate, rarely acute, obtuse, or slightly cordate, apex obtuse, rarely acute but shortly acuminate, acumen up to 1 cm long, often slightly curved, margin entire. *Venation* slightly prominent above, prominent beneath, secondary veins in 9–12 pairs, sinuously curved and branched towards the margin, joining the next second-

daries and forming outer secondary veins, tertiary veins distantly percurrent, irregular and sinuous; intercostal areas somewhat bullate when dry; leaves glabrous; dark olive green when dry, glaucous underneath in natural state (sec. coll.). *Inflorescence*: multibracteate glomerules of up to 8 sessile flowers, not terminal and not at special leafless branches. *Bracts* narrow-triangular, 2–2.5 by up to 1.3 mm, brownish velutinous to tomentose. *Pistillate flowers* 5–7 mm diam., pedicel at most 0.3 mm long, staminate flowers not seen. *Sepals* narrow ovate-triangular, subulate, up to 3.5 by 1.5 mm, sparsely pilose at base. *Petals* and *disc* not seen. *Filaments, anthers, staminal column, pistillode* not seen. *Ovary* ellipsoid, pubescent, styles c. 2 mm long, united in the lower part, free and bilobed in the apical third, exserting, stigma lobate. *Infructescence* with up to 5 fruits, sometimes up to 1 mm stalked. *Fruit* ellipsoid to ovoid, apex acute, base rotundate, up to 12 mm long and 8 mm in diam., i.v. yellow green, i.s. blackish; mesocarp fleshy. *Putamen* woody. *Seed* one per fruit, compressed ellipsoid with lateral furrow, 8 by 6 by 4–5 mm; testa purple to dark brown, rugulate. — Note: The description is based on a single fruiting collection.

Distribution — Malay Peninsula, so far only known from the type locality. — Map 7.

Habitat & Ecology — Rocky streambed; 240 m altitude.

Notes — 1. With the unilocular and one-seeded fruits as well as the lack of the fimbrial vein this taxon clearly belongs to sect. *Cleistanthoideae*. The general appearance (leaf shape, fruits) recalls *B. penangiana* but the flowers are much larger and the leaves are stiff and coriaceous. With these features the taxon is quite close to *B. balansae*, but the leaves are rather different: they are neither lanceolate nor acute at the base, and they are of a conspicuous olive green colour when dry. An interesting feature is the somewhat bullate structure of the intercostal areas in sicco. The habit as a big woody climber seems to be unique among the taxa studied. Merely *B. cinnamomea* and *B. stipularis* grow as scrambling shrubs. The roughly lenticellate branches are reminiscent of *B. pustulata* but the leaves are not blackish when dry, they lack the closely scalariform higher venation, and the plants show only small few-flowered inflorescence cushions which are not strongly protruding.

2. Further material is required to judge the justification of the taxonomic rank and to clarify the position within the section.

SPECIES DUBIAE

Of the following taxa no type material could be traced or obtained so that their taxonomic status could not be proved.

Bridelia chineensis Thin, J. Biol. (Vietnam) 9 (2) (1987) 37. — Type: *Nguyen Nghia Thin & Do Van Mteng NT-1824* (HNU holo), Vietnam, Hasonbinh, Chine, 7 July 1985.

Note — According to the protologue this species would have close affinities to *B. retusa*. The supposedly distinguishing features mentioned (e.g., obovate chartaceous leaves with obtuse to roundish base, inflorescence not robust, pistil not ovoid) are all to be found in the latter and do not seem to justify the distinct taxonomic recognition at all.

[*Bridelia kawakamii* Hayata, J. Coll. Sci. Tokyo 22 (1906) 362, nom. nud. — *Bridelia monoica* Merr. var. *kawakamii* (Hayata) Hurusawa, J. Fac. Sci. Univ. Tokyo III, 6 (6) (1954) 321]. — Type: *T. Kawakami s.n.* (probably TI), Formosa, Koshun, 1904.

“Diagn. will soon be published in supplemental notes” (did not happen!).

Note — Hayata (Mat. Fl. Formosa, 1911, 263) cited this nomen nudum under his *B. ovata* (non Decne.) which later authors (Croizat & Hara, J. Jap. Bot. 16, 1940, 314) identified as *B. balansae*. However, Keng (Taiwania 6, 1955, 38) synonymised it with *B. monoica* (Lour.) Merr. (= *B. tomentosa* Blume). The true identity can only be decided after examination of the type material which is suspected to be housed in TI, but could not be obtained.

Bridelia nayari P. Basu, J. Econ. Taxon. Bot. 7 (3) (1985, publ. 1986) 634. — Type: *N.G. Nair 909* (PBL no. 909A holo; PBL no. 909B iso), India, Car Nicobar Isl.: Malacca, 1 March 1974.

Note — In the protologue it is stated that this species is very similar to *B. tomentosa* but differs in being completely glabrous. This is not at all unusual in this taxon (cf. *B. tomentosa* var. *glabrescens*). However, the fact that *B. nayari* is described to have coriaceous leaves seems unusual. As I have not seen type material of *B. nayari* I do not dare to synonymize it with *B. tomentosa*, although this seems to be the most probable variant.

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